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kilobaud™

The Small Computer Magazine

ISSUE #12

December 1977

Articles

Features

the Computer Store, Inc.

C34

the store for the professional

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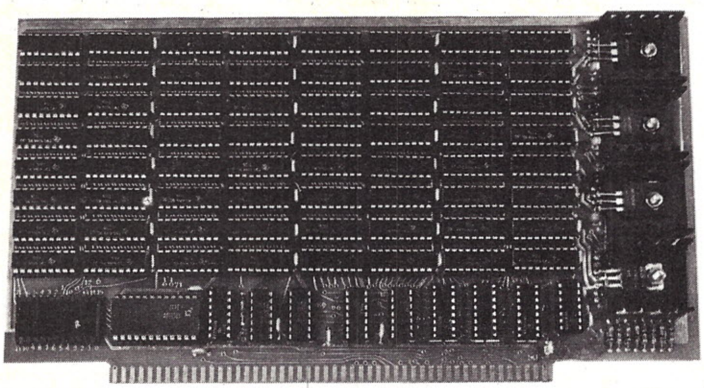
WANG

*

new product announcement

The Computer Store is pleased to announce the WANG PCS-II as a new line, stocked for delivery. The WANG PCS-II is a compact desktop computer designed for accountants, engineers, businessmen and administrators. The standard unit contains a video screen, keyboard and mini-diskette. Price: $6,600.00

32K Static RAM



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16K = $545
8K = $350

- Each 4K block may be strapped to any 4K address boundry.
- All ICs 100% dynamically tested and burned in.
- Solder masked PC board.
- Gold-plated edge connector.

Designed, assembled and tested to the Computer Store's own rigorous specifications.

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- Can be loaded in 4K increments.
- Assembled, tested & burned-in.
- All I/O lines buffered.
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- Warranty 120 days on parts & labor.

WORLD'S ONLY COMPLETE RETAIL CENTERS FOR MINI- AND MICRO-COMPUTERS, PERIPHERALS, SUPPLIES, SOFTWARE AND SERVICE:

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PUBLISHER'S REMARKS

Wayne Green

Marketing Strategy for Dealers

With sales to small business increasing steadily, many dealers want some ideas on how to sell to this market. Obviously it is worlds apart from the hobby market in that businessmen are looking for computer systems that are all ready to go, complete with programs. They are not looking for kits; saving a few dollars on memory or I/O boards is of little interest; and having to learn BASIC so they can generate even the simplest programs will stop the sale.

The business market may be the real savior of the computer store. Many, if not most stores, find themselves hurting badly because so many manufacturers are inexperienced in marketing and try to set up discount schedules that are unrealistic. When it takes four or five hours per customer to make a systems sale plus an equal amount of time for hand holding and service later, this money has to come from *somewhere*. A 25 percent discount to the dealer does not begin to make this pay. Manufacturers in other fields have found that 33-40 percent discounts are best for keeping things moving.

There is a way around this situation for computer stores! Sell business systems instead of hobby systems and components. A system for a small business can then be a mixture of several manufactured components plus an attractive console and programs. There's no way to put a hard-and-fast list price on such a package, so those low manufacturer discounts can be ignored to some extent. Manufacturers will find that dealers will tend to try to deal more with suppliers who offer better discounts, and as the market grows we should find unrealistic suppliers gradually going belly up . . . or at least learning the fundamentals of marketing the hard way.

Hobbyists have settled in on an average investment of $2000 per system. This wasn't too bad when there were not many computer stores and a lot of hobbyists did not yet have their systems. Now, with more stores opening almost every day, and with the percentage of hobbyists who have yet to make a major commitment to a system down well under 10 percent, the dealer who does not recognize the changes taking place is (or is going to be) in deep trouble. This is quite different from just a year ago when about 90 percent of the hobbyists had yet to make major purchases. This group of people has done the most to keep the industry going and has supplied the growth money for manufacturers.

Unless some new source of hobbyists is found – and quickly – suppliers and dealers geared to the hobbyist market are likely to be on hard times. This is a bitter pill in an industry that has been growing almost beyond belief.

Cost per Month Is the Key

Many dealers have been thinking in terms of $500 CPUs, $250 I/O boards, $600 printers, etc. Businessmen who are new to microcomputers, and this includes 100 percent of them, think in business terms. When they buy a copier they want to know the cost per month on lease-purchase . . . and the cost of a service contract. If you are going to sell to businessmen, you have to have these answers.

There is no reason on earth to talk to businessmen about $2000 systems. Even the smallest of businesses can afford a $12,000 system . . . and, if you are honest about it, you really can't offer a good-looking and performing business system for much less than that. To sell it at $11,800, you'll have to put it all together for around $7080, including the programs. On a lease basis, this will come to about $295 per month . . . about one-half the cost of one additional clerk for the business. This gives you a powerful selling tool. For half the cost of adding one more person to the staff to type invoices, statements, letters, mailing lists, do bookkeeping, etc., a microcomputer can be brought in that will do the work of six people.

Standard vs Deluxe

By offering a choice of systems that really isn't much of a choice, you'll give the customer something to think about. You want him to decide whether to buy the standard or deluxe system, not whether to buy a system or not to buy it. Be sure to give the customer the right choices to make.

With the standard system selling for a mere $295 per month, perhaps the deluxe model should weigh in at $395. This would be a $15,800 sale, and you could afford to spend up to $9480 on it.

What should a system have for business? Since microcomputers can easily replace several office typewriters, you'll probably want one nice printer. It is so much faster and cheaper to type letters on a CRT and have them printed out automatically when they are edited that this function alone will sell systems.

Since you don't want to wear out your good printer with things like labels, it might be worthwhile to have a small, faster, printer to knock out mailing labels, daily work reports such as inventory lists, sales totals, etc. This could be one of the inexpensive 40-column printers.

You'll probably want a dual or triple disk system. Will the mini-floppy save enough money to be worthwhile? Will you want regular-size floppies with double sides and dual density? After talking with businessmen, you'll find the answer to this . . . probably the majority have a few hundred accounts and a few thousand inventory items at most.

Firms with large mailing or customer lists may need to go the hard-disk route . . . super deluxe . . . at $595 per month (and worth it). This nets out to about $23,800 for the sale, which means you can put $14,280 into it. The new $4800 50-meg disks look attractive at that price. You could even get one of those into the deal at $495 per month if you had to.

How to Get Started

A lot of hobbyists see what is happening in this field, but don't know how to take advantage of it. It costs a lot to open a computer store, and it takes a lot of experience to undertake such a project . . . how does one get the experience and the money?

My suggestion is for hobbyists to take every advantage of the hobby part of microcomputing. The main entry into the business end of microcomputing is via servicing . . . if you know how to fix microcomputers you'll have to fight off store owners with a stick to keep from being hired. And how do you get good at fixing them? You do that by indulging yourself in your hobby until you are in nervana [sic].

Many hobbyists have two, three or four systems up and running. Others find that if they get a system

together and working they have no problem at all selling it to someone who doesn't want to go through all that hassle. Fine . . . it's the hassle that is valuable for you. And once you're into getting things running you'll find other hobbyists with systems that have problems and who will be delighted if you'll help them troubleshoot. Your local dealer will probably be happy to put you in touch with hobbyists who need help. You might even put a card on his bulletin board offering help.

If you follow the above advice you'll get a good start in the field and have fun while you're doing it. When you're ready, I'll offer a few more suggestions.

Service Bonanza

Don't overlook the money to be made in servicing microcomputers. These gadgets are complicated enough so there is going to be a shortage of good servicemen for a long time to come. Get the best people you can, lean on the suppliers for everything you can get in service data and diagnostic programs, get what you can in sophisticated service equipment, and you'll be able to provide a salable commodity to other newer computer stores in your area. Thus, instead of fearing every new store that opens, you'll welcome them as a source of more income for you. You might give them a part of the contract as an inducement to let you handle the servicing.

What Can You Offer?

Have you given much thought to what you can put together for around $7080? It's time to get out the price sheets and a scratch pad and start putting some systems together on paper. The next step is to set them up and get them working . . . then get an enclosure made for them that will look good in an office environment.

You'll need the fundamental programs to sell these systems . . . payroll, statement printing, editor, inventory, general ledger, etc. If you haven't a good source of these, perhaps you'll be able to get them from *Kilobaud.* If you have some good programs already, then you should talk with *Kilobaud* about further distribution of them . . . there could be enough profit in them so you wouldn't even want to bother running a store.

Kilobaud Forum

As you work out systems to sell to business, we would like to know what you've chosen and why. We'll pass along your ideas in *Kilobaud*, and perhaps the result of this will be important input for suppliers . . . on features and pricing. It certainly will generate some steam and a lot more ideas for everyone.

If you run into areas where equipment that is not being made is needed . . . or where some features that are not yet available would be helpful, pass along your ideas and you'll soon see them become realities.

Replacing the Mail

The sooner we can start interconnecting our micro systems via the telephone lines, the better. I'm sure I don't have to convince you that there is a serious need for an effective alternative to the mails . . . and I think microcomputers are the answer.

We do need an interface that will connect to the phone lines and allow our contraptions to send letters from one system to another . . . call it data, if that pleases you. With the late-night telephone rate running around 19 cents for a one-minute phone call, I think we should take advantage of that as a mail alternative. Letters are 13 cents now, but they will be up to 19 cents before long.

We will need a good text-editing program so we can write letters on our systems and edit them. Then we need to have a real-time clock so we can program the system to make the phone call at a specified time. The interface should be able to dial the number at the right time and keep at it every few minutes until a connection is made. When the phone is about to ring, there should be a disconnect tone, which will turn on the receiving computer and not wake up the recipient. Once a handshaking signal is received, your system should send the letter to the other computer, complete with some error-detecting and perhaps correcting system. When an acknowledgement is received, the system would disconnect.

On the other end, the system will probably turn on a light to indicate a letter is waiting . . . sort of like the message light on hotel-room phones.

In order to get this moving, we need articles on suggested protocols and standards. I'd like to see experimenters build up some test systems and wring them out . . . complete with articles.

The next step is to encourage the manufacture of a telephone I/O board that will do all of this for us. You may be sure that *Kilobaud* will do all it can to encourage the use of such a gadget. I'd like to start publishing the phone numbers of people who get set up to use such a standardized system. For 19 cents, we may get reckless and send letters to people just for fun.

As soon as something like this is going, you may be sure that I'll be getting on radio and television programs and letting business know that such a money-saving service is available. The first users will obviously be hobbyists, but how long will it take before there are some commercial uses

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EDITOR'S REMARKS

John Craig

What The Hell's Going on Here?

Yeah, what *is* going on? Where did this practice of advertising a product before it's finished come from? Is it because of the two-month lead time for magazine ads and everyone figures the bugs will be ironed out by then? Baloney. During the development of a hardware or software product, there isn't any way someone can anticipate that the thing will be ready to go in two months . . . there are just too many variables – most of them unanticipated. The whole situation is *bad news* . . . and it's generating a mile-wide credibility gap in this industry!

There's no excuse for this stuff . . . and I'm getting very tired of getting letters from dissatisfied people (make that *frustrated* people) who have sent their monies to various companies and then have had those companies deliver nothing but delay notices and promises. This game has been played with complete computer systems, disk systems, printers, memory boards and just about everything else you can think of. And everybody is doing it: large companies, small companies, those that are established and those trying to get their foot in the door.

Going back to the first sentence in this paragraph . . . maybe there *is* an excuse. If there is, I would certainly appreciate some response from the manufacturers. I'll be sending a copy of this editorial to a number of manufacturers (along with the letters to those who have them coming). Let me clarify that last statement. I'll be sending copies out to manufacturers who may, or may not, have had delivery problems in the past. I'm not at all interested in accentuating the negative with this effort . . . let's hear about some of the positive experiences also. We can all learn from the times when delivery schedules were met as well as the times they weren't. I'm not trying to put anybody on the spot, and I'm certainly not throwing out any threats (I once knew an editor who did that in a similar situation . . . and he's now an ex-editor). All I'm looking for is for the manufacturers to share with us the reasons why these things happen (i.e., a little more detail than can be obtained from a delay notice) and the reasons for their successes (which we all too often take for granted).

Undoubtedly, certain manufacturers will feel the tone of this editorial has put them on the defense and, therefore, they'll decline making a response. That's a cop-out. As I said before, I'm not trying to put anybody on the spot . . . I'm just trying to shed some light on the situation. As far as my tone is concerned (particularly in the beginning – I seem to tone down a little as I go on) . . . I wouldn't change it a bit. I'd like to think I'm speaking in behalf of tens of thousands of computer hobbyists who are all getting a little bugged by the situation. The recent situation with DataSync Corporation illustrates why this is a matter of concern for us all. "Colonel Winthrop's" objective was to advertise products that didn't exist, accumulate a couple of hundred thousand dollars and then take off. There are some companies in this industry that appear to be doing the same thing . . . and that's the worst part – giving the *appearance* of such activity.

Perhaps the best thing to do is simply wait until you've seen a particular product or heard from someone who has. Wait until it gets into your local computer store rather than buying blindly the first time you see an ad in a magazine. Notice I said "the first time" you see an ad. There's a lot to be said for the stability and long-term nature of a company that is able to *consistently* advertise its products. What I'm trying to say is, "Beware of those shots in the dark."

I've run across some companies, large and small, that make it a definite policy to wait until a product is ready for this marketplace before announcing. If some can do it . . . why not all?

Addressing the Small Business World

Starting next month, we plan to set aside a section of *Kilobaud* that will be devoted to articles aimed toward the small businessman . . . and how he can use personal computer systems. The articles will discuss the systems and applications that are available . . . not "blue-skying" or proposed systems. We're going to have articles written by the people who have developed such systems. They'll emphasize the advantages of using a personal computer system in a business, system requirements, maintenance, operation, cost and ordering information.

We're all aware that software is most lacking these days. Therefore, I'll be particularly interested in articles describing general-purpose and specific software-application packages.

One of the most important things for authors to keep in mind is that they will be addressing, for the most part, novices in this field who will be *users* – not technically oriented individuals. A good example to follow is the kick-off article by Robert Brehm, appearing next month, which describes the Promedics Data Corporation system for medical professionals.

There will be a lot of articles written by various manufacturers describing their products. This is fine and dandy because it's doubtful anyone else could do a better job of describing their products; these articles also will be "horn tooting" affairs. *But* . . . I honestly prefer to see objective reviews of such systems *written by the users* who buy them. If you're a manufacturer (large or small) and you don't have the time, the knack or the personnel for generating articles about your system, then at least contact some of your customers and put them in touch with me, OK?

Low Cost Software Development?

Are you a manufacturer in need of some good applications software? Are you a hobbyist putting together small business systems, and you also need some applications software developed? No matter who you are or what your need is, I have a suggestion for a solution.

Hal Singer, editor of the first computer hobbyist newsletter (*The Micro-8 Newsletter*), is a math instructor here in Lompoc CA, and he has a knack for producing some outstanding programmers in his computer classes. Several manufacturers, such as the Digital Group and Polymorphics, have loaned systems for his students to use in developing applications software for those systems. The manufacturers are making out like bandits in getting this software developed at a low price, and the students are making out as a result of the experience they're getting, *and the monthly royalty checks they receive!* One of Hal's most recent geniuses is a young man named David

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AROUND THE INDUSTRY

John Craig

Texas Instruments recently sent us one of their new "Programmer" model calculators for evaluation. I've always felt someone would eventually come up with a decimal/octal/hexadecimal calculator for us computer types . . . I just wish it had arrived sooner. After using this one for a couple of weeks, I've come to the conclusion I wouldn't ever be without it (TI loaned it to me . . . but, rather than return it, I think I'll buy it!).

Trying to do even the simplest hexademical arithmetic has always been a pain for me. For example, if you wanted to find out how many memory locations a particular assembly-language program occupied, you would simply subtract the starting address from the ending address, right? Here, put this one down on paper just to give it a try: 1D00 minus 153F. After going through all that base-16 borrowing, you come up with a hexadecimal answer (it's hoped) . . . which isn't too meaningful. It will have to be converted to decimal to be of any value, right? You remember how to do that, of course. You learned it way back in your early college days . . . or was it that first tech school you attended for programming or digital electronics?

There's an easier way! First, grasp your trusty "Programmer" in your left hand and hit the ON button with your right (or vice versa for you lefties). Next, hit the HEX switch, which will put you in the hexadecimal mode of operation (indicated by a quote sign (") at the left side of the display). Hit 1D00 . . . then the - sign . . . then 153F . . . and then the = sign. Aha, we have a hex answer of 7C1. To convert this to decimal, we simply hit the DEC key and the conversion is performed . . . 1985_{10} locations. As a matter of fact, if we wanted to see what 1,985 is in octal, we would simply press the OCT key (and get an answer of 3701). The octal mode is indicated by a single prime sign (') at the left of the display.

The preceding was a simple example of having to do hexadecimal calculations (and octal, of course). I would think the greatest value to be derived from this little gem would be when we want to do some hex arithmetic operations within a machine-language program . . . and being able to run through the whole sequence in *decimal and hex* with the calculator first.

How about getting two's complement of a number? Simple. Enter the positive value of the number in octal or hex and then push the ± key in the lower right-hand corner (see Photo 1). You have the two's complement. Depressing the key again will take you back to the positive value.

Referring again to Photo 1, notice there are several *logical* functions that you can perform with the Programmer, also. For example, you can take the Exclusive OR (XOR) of two values or perform a logical AND or a logical OR. Left shifts, one bit at a time, are possible using the SHF key. For example, enter IF, then SHF, then 1 (for 1 place), then = . . . and you get an answer of 3E.

Parentheses, along with memory store, recall and sum operations make the Programmer a good general-purpose decimal calculator. Unfortunately, I don't find myself using it for everyday math. I say "unfortunate" because I feel TI sort of dropped the ball in the human engineering department. The Programmer sits on my desk right next to my old reliable TI SR-10 . . . at the same angle shown in Photo 2. At that angle I can reach over and easily see which key is which on the SR-10. I can't see the labeling for the keys on the Programmer. In order to use the Programmer I have to pull it over to me. Now, it's not that I'm lazy . . . it's just that I think they did a much better job with the nice big keys on their older calculators (but then, the newer ones have a lot more functions, don't they?).

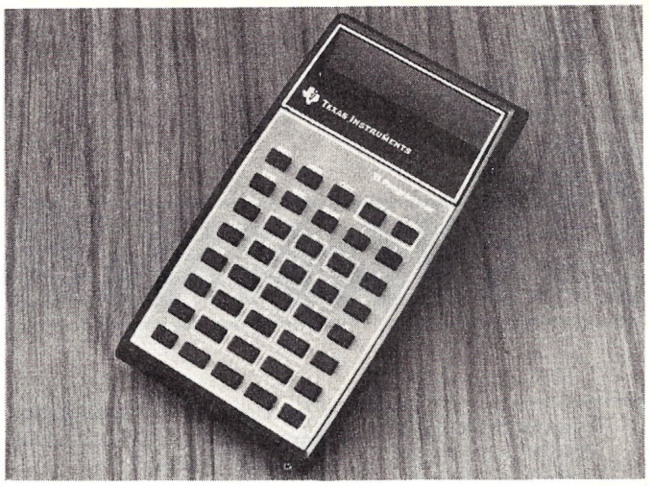

Photo 1. TI's Programmer calculator . . . from hex to dec.

One other minor fault I found with the Programmer is that it will not directly convert noninteger values from one base to another. But, with a little minipulation (described in the manual) it can be done.

As I said, I don't ever plan to part with it. It's the greatest boon to computing since the microprocessor (and, of course, I *never* exaggerate). The calculator is being test marketed initially on a direct-mail basis from Texas Instruments. Got that? *Test* marketed. That means we'd better get busy and buy some . . . or they'll probably take it off the market. The price is $49.95. Heck, I'll gladly pay that just to keep from ever having to do another hex calculation on paper again!

Texas Instruments Incorporated, Inquiry Answering Service, PO Box 5012, M/S 84 (Attn: TIP), Dallas TX 75222.

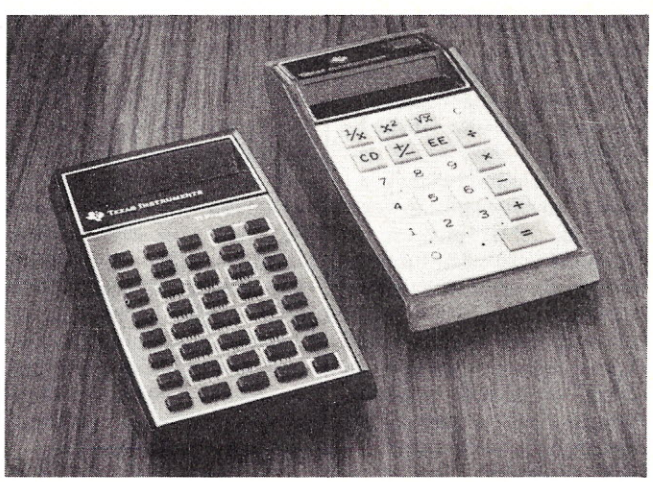

Photo 2. Comparison of Programmer and SR-10 shows the latter's more convenient operating stance.

BOOKS

Your Own Computer
Mitchell Waite and
Michael Pardee
Howard W. Sams & Co.

How many times have you heard, "When is someone going to write a book about personal computing that I can give to my friends who know nothing about computers?" I have been searching for such a book for the last three years; I think I finally found it.

Your Own Computer is available from Howard Sams and Co. It is short, easy to read and seems especially designed for the person who doesn't know what a personal computer can do, but does know the value of high technology.

The preface nicely sums up the authors' goals:

"Today few people realize that a computer for the home can be purchased for about the same price as a good stereo system. Retail stores are already making plans to sell you "your own computer" and advertising campaigns will soon herald the home computer as the consumer product of the future that's here now. In order to understand and appreciate the fantastic value of this new product, consumers will need to become familiar with what these inventions can and can't do. The purpose of this book is to introduce the novice to the new home computers and to reveal in the simplest possible terms the incredible potential of these technical marvels. Because of the stigma of complexity and mystery that surrounds the computer, it is hoped that in these pages you will find that in fact computers are simple, easy to understand, and most of all extremely helpful devices."

Although I don't believe anybody can make a computer simple to understand, I found that the authors did come unusually close.

I was particularly impressed with the organization of the book. It started with a fast, easy-to-read introduction and ended with a chapter on how to get started in personal computers. When you finish the book, the authors provide the next step to take. There are several paths of involvement, and each is weighed for its intensity.

The introduction basically answers the question: What are personal computers, where did they come from so suddenly and where are they going? The evolution of the personal computer is traced from the transistor to the space race, through digital watches, pocket calculators and TV games to the product that is emerging today called the home computer. It's a nice, simple introduction that lays good groundwork for the next question we all seem to come up with: "So what can you do with a personal computer?"

Chapter two is about applications for the personal computer and is written with the attitude: "Hey, you guys, look what you could do with a computer in your home, in your business, in the classroom, or just for pure fun!" Under each of these classifications the authors describe three or four ways a personal computer could be used.

For example, "In The Home" describes the personal computer's being used as a home accountant, for personal income tax filing and for management of domestic resources (food, energy, security). Each application is illustrated by Robert Gumpertz, with some warm and happy characters involved in their computers.

The next chapter is called "Programs For Your Computer." Here the authors have included what most books seem to miss. Software will be the most confusing aspect of the computer as a consumer product. Most people know nothing about it; in fact, most people feel it's a confusing word to use; and many hear it as a computer "buzz" word designed to put distance between the educated and the uninformed. So, it is nice to see the authors approach the subject of programs for your computer directly, before going into the hardware that makes computers tick.

First we discover the main difference between a computer and a toaster – that computers are programmable – and then what writing your own programs involves. Finally, the chapter concludes with how to go about using other people's programs, which the authors say is probably the way things will eventually go.

Chapter four is about the devices that make a computer work or, as the title suggests, "Nuts and Bolts." The chapter is designed so that after reading it you can safely go into a computer store and not be totally snowed by what the owner is talking about.

The chapter is divided into two main parts. One describes what hooks up to a computer: control panels, keyboards, displays, teletypes, cassette recorders, floppy disks. The second part describes things that go inside a computer: memory, interfaces, etc. The material is brief, but it does give a good picture of the hardware you will find being sold in computer stores. The authors do take the time to mention that when computers are operating more extensively in department stores, the amount you will need to know about hardware will be very little. For now, however, knowledge is required.

For those of us who sometimes must look ahead to see how the book ends, the last chapter is the most sobering. Getting started in personal computing takes time and energy. (But the rewards are immense, and as a programmer might say, it's pure "blue sky" for future computer users.)

Several alternatives are described: educating yourself, visiting a computer club, going to a computer fair, reading, etc. Next, the chapter asks you to define how deep you're willing to get involved. There is a brief mention of what it's like to buy a personal computer, but I would like to have seen more about buyers' guides and assistance. The book ends on an up note called "Free computers." Here the authors suggest that given the right type of person, with about $1000 for an encyclopedia from mom and dad and a high level of interest, you can get a computer to pay for itself and also make a profit, right in your own home.

That's a nice way to end, but I'm not totally sure that's all there is to it. The authors failed to mention the fantastic amount of work involved in getting a computer project running, and how one ever would go about doing it.

At the back of the book you'll find two appendices. The first is just what the computer store people ordered – a simplified glossary of computer buzzwords. I wish it were larger, but it's not bad and can be read through in less than 15 minutes. Appendix two is a listing of popular computer acronyms – those alphabet-soup abbreviations that keep us separated from the rest of the world. I'd like to see them all given up.

In toto, I'd say this is really a fine book. You may consider, as I have, buying enough copies to satisfy friends who would like to get involved in personal

computing, but don't know a darn thing about it.

Michael Stone
San Anselmo CA

Getting Involved with Your Own Computer: A Guide for Beginners
Solomon & Veit
Enslow Publishers

Several writers have pointed out the need for providing simple, easily understood materials for the computer novice who wants to get involved but doesn't care about all the technical stuff. The newcomer wants to sit down at a machine, turn it on, and *use* it to perform a task or play games.

The problem for many people has been the lack of enough background information to read the magazines and ads with any understanding. There are several "introductory" works, but they are invariably long dull lectures on chip architecture or binary, octal and hex programming. While there is a place for these, they are too technical for someone who just wants to learn enough to get a system up and running in the most efficient manner.

Getting Involved with Your Own Computer provides that sort of information. It is a survey course on hobby computers and has the necessary technical information so that you can understand what a computer is and evaluate the advertisers' literature. You learn the difference between a RAM and ROM, an octal and a BASIC program, and what kinds of components are necessary to put a computer together. There is also a summary of basic equipment and software available from several manufacturers. The book is sufficiently up to date to contain some information on the PET, Apple II and Xitan.

The book also discusses various magazines, books, clubs and stores where the beginner can supplement his knowledge on BASIC computer components, and the elements of memory storage are explained in a manner that most nontechnical people will probably grasp.

Preceding the sections on peripherals, inputs and outputs are a few chapters on the types of products available; an introduction to training devices and evaluator kits, one-board computers and kits vs assembled units is followed by a review of companies using the S-100 bus (Altair, Imsai, Sol, Poly-88, Vector and others).

Reports on various 6800 computers, including SWTP and Jupiter are included. There is a separate chapter on the Digital Group and one on companies that do not use the S-100 bus. Other chapters provide information on peripherals and components as well as reviews of products by various manufacturers. A chapter on software gives a rundown on types of software and explains the nature of various languages, including machine language, assembly language, BASIC, word processors and so forth.

A final chapter puts personal computers into perspective for the hobbyist, as opposed to the many grandiose claims about the computer running everything from your home to your office. Not that it isn't possible to do all that and, eventually, even at a reasonable cost; but to the beginning hobbyist those schemes are still a long way from realization.

Since this is an introductory book, it is hard to fault it for omissions, but other information might have been useful. I would like to have seen a comparison of different chips. Also, the book does not provide enough information on the cost of getting various systems up and running.

Finally, given the introduction of the PET, with its IEEE-488 bus standard, the authors could have speculated on what that might mean for someone who chooses to buy that particular machine.

My criticisms should in no way discourage anyone who needs an overview of hobby computers. This book is one of the more valuable contributions to the hobby literature.

Gary Greenburg
Jackson Heights NY

Instant BASIC
Jerald R. Brown
Dymax 1977, $6

This book is aimed squarely at the novice. It is suitable for those wishing to learn BASIC with little or no background in computers, programming languages or mathematics.

The book has the outward form of a workbook: soft cover, notebook-sized pages, numerous examples and exercises. But the notion of a dull, drab tutorial text is quickly dispelled. Brown's writing style is entertaining as well as instructional – rich with humor and personality. The book is filled with cartoons, illustrations and eye-catching graphics. Somehow, these seeming distractions serve to augment the instructional material, not detract from it. If you've given up learning BASIC because of a dry reference manual, this should be your answer.

Mits 8K BASIC version 3.2 is used in the examples. Although BASICs are similar, and the book would be useful in conjunction with any form of BASIC, its greatest value will be to those with some version of Mits (Altair) BASIC. Digital Equipment Corporation's BASIC Plus, a language similar to Mits BASIC, is also accommodated in the book. The author points out where the two languages differ.

Brown is adamant about using the book as an active participation workbook. Numerous examples and exercises are provided. The reader is implored, practically begged, to try them out on his machine. This approach is to be applauded. Much of programming is an art, and no artist can perfect his skills without considerable practice and attention to detail. By constantly getting his feet wet, the student will become familiar with programs that work – and with ones that don't. Many examples of the latter are given. The reader will quickly become acquainted with various error messages and typical programming pitfalls.

The author has given much thought to how to present BASIC to the beginner. He feels there are three programming concepts that often cause problems: conditional branching (IF . . . THEN), looping or iteration (FOR . . . NEXT) and arrays (subscripted variables). These subjects are treated carefully.

String variables are introduced immediately, which enables the reader to see the computer "talking in English." Assignment statements and data entry (READ, DATA, INPUT) come next. Looping and GOTO soon follow.

Next come conditional branching and automated looping (FOR . . . NEXT). Subscripted variables are withheld until near the end. Last comes subroutining. Interspersed, of course, are the various other functions and features of BASIC.

Brown consistently avoids references to anything that is machine (or installation) dependent. This seems at best a two-edged sword since the reader is denied a certain overview. It is simply assumed that he has access to a machine with BASIC. The following questions are ignored: What is BASIC? (itself a program executing in machine language); how is it entered into the machine? (ROM, cassette or disk to RAM, etc.); how was it designed? (interpretive, thus allowing direct mode statements).

These omissions are obviously intentional. Probably, they were considered "red herrings" that would only confuse the reader. There is some truth to this,

(continued on page 25)

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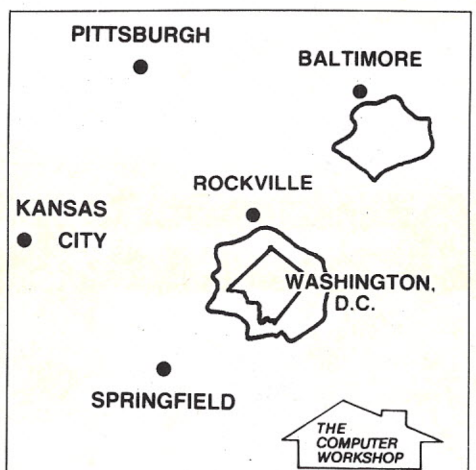

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NEW PRODUCTS

OSI's Complete Computer

Challenger IIP is a new personal computer complete with BASIC in ROM and RAM (4K) for programs in BASIC. All you have to do is turn it on and go.

Challenger IIP is a self-contained personal computer with a full size keyboard and a 32 x 64 character video display interface.

Complete with an audio cassette interface, the Challenger IIP connects to a video monitor or home TV set via an rf converter (not supplied) and optionally a cassette recorder for program storage.

Challenger IIP comes with a 4-slot backplane and case for $598, and is compatible with all OSI accessories. Ohio Scientific, Hiram OH 44234.

OSI Announces 74 Megabyte Hard Disk

OSI's C-D74, for small computers, provides 35 ms average access time to any of 74 million bytes of information. It is the first drive with 12 tracks on a cylinder without reseeking, and can access any of 220,000 bytes of information in 5 ms.

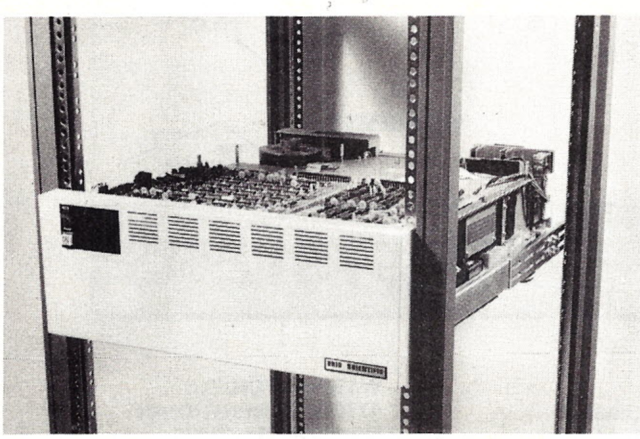
The C-D74 can store all the records of a medium-size company for instant access, and the drive can run 24 hours a day without worry of disk wear.

The 74-megabyte disk has important applications in both business computing and research, and makes small computers practical for much larger jobs.

With a 10 ms single track seek, the drive has a data transfer rate of 7.3 megabits per second.

The drive, cable, interface for an Ohio Scientific Challenger and OS-74 operating system software is $6000 F.O.B., Hiram OH 44234.

Ohio Scientific Challenger IIP.



OSI's 74 megabyte hard disk.

TI Calculators Feature Solid State Software Libraries

Featuring plug-in, Solid State Software libraries, the Texas Instruments Programmable 58 and 59 calculators bring significant additional program memory capability and programming flexibility to advanced students and professionals in business, engineering and science.

Suggested retail price for the TI58 is $124.95 and for the TI59, $299.95. Both models can use interchangeable software modules with prerecorded program libraries containing up to 5000 steps each.

The TI59 also has magnetic-card memory capability. Up to two cards about the size of a stick of chewing gum with an additional 960 program steps can be loaded into this calculator.

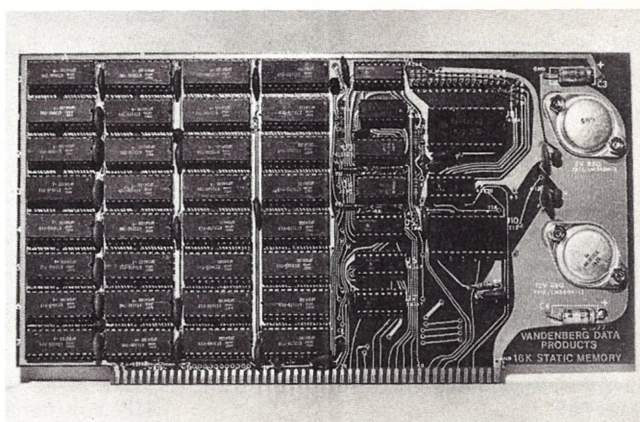
Otherwise, the two calculators differ only in storage capacity. Users can partition the TI58 with up to 480 program steps or up to 60 memory registers. They can do the same with the TI59 with up to 960 steps or up to 100 memory registers.

So that users can put their machines to work more quickly and obtain maximum benefits of programming, TI has developed new instructional material in a "Personal Programming" book form to replace the traditional owner's manual.

Both new programmables have up to ten registers available for looping, increment and decrement – and the same number of user flags for set, reset and test. Up to six levels of subroutines are available, and four types of display testing with an independent test register.

Users may edit their programs readily, using such

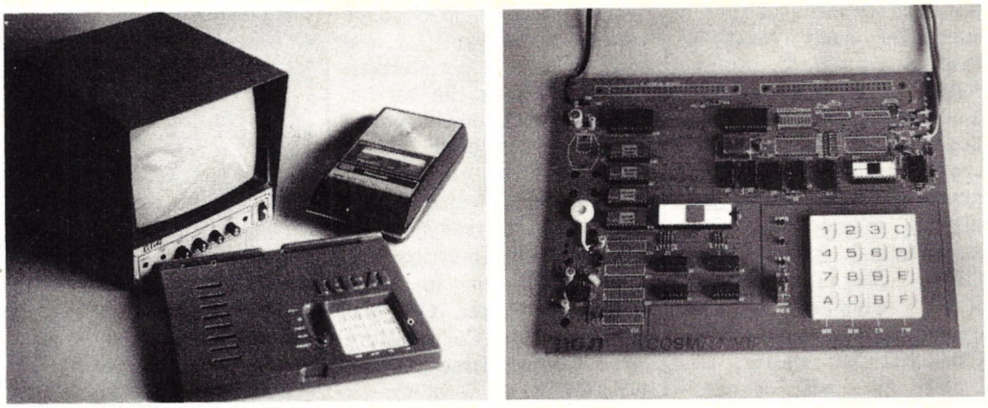
Texas Instruments Programmable Calculator.



Static RAM from Vandenberg Data Products.

keys as insert, delete, single step, backstep and no operation.

The two programmables feature an Algebraic Operating System (AOS), which allows even complex equations to be entered the way they are algebraically stated, from left to right. AOS enables the calculator to execute problems automatically according to the rules of algebra. Up to nine sets of parentheses allow up to eight pending operations. Texas Instruments, Inc., PO Box 5012, Dallas TX 75222.



RCA's new COSMAC VIP uses CDP1802 microprocessor.

16K Static RAM from Vandenberg Data

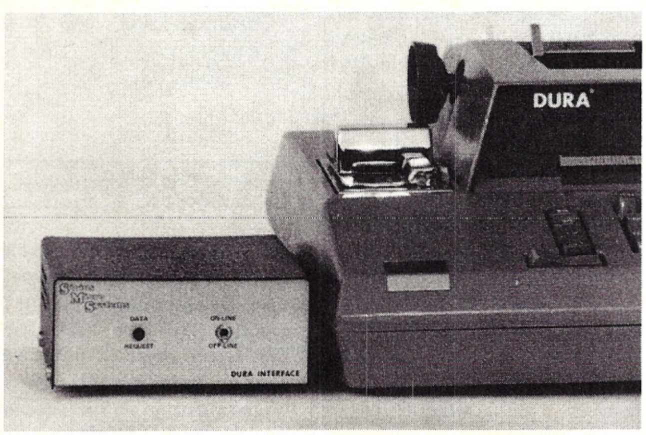
An S-100 bus compatible 16K static RAM card designed for 500 ns systems is now available from Vandenberg Data Products. The card has very low power requirements and can be run in many systems without the fan operating. It has a fully buffered bus, low-power Schottky TTL logic and tested ICs. The board is soldermasked on both sides with gold-plated contacts, plated-through holes and silk screen including component identification, addressing designations, test points, bus numbers and memory-bank array markings. There are low-profile sockets for all chips.

Each 4K segment may be assigned a starting address on any 4K boundary. Extra address lines are provided for memory-bank operation under external memory-bank control. The card does not require a front panel for generation of MWRITE (pin 68), allowing use of the memory on a stand-alone bus and CPU.

The assembly manual includes a section on theory of operation, detailed assembly instructions, memory test, troubleshooting guide and procedures, memory timing diagram, IC pinout and logic diagram, schematic, and component layout diagram. Price is $365 in kit form, or $450 for the assembled and tested unit. Vandenberg Data Products, P.O. Box 2507, Santa Maria CA 93454.

Two New Interfaces for Dura Mach 10 Terminals

Sirius Micro Systems announces two interfaces for the Dura/Itel Mach 10 or Model 941 Selectric-based terminals. Both connect to standard TTL parallel I/O ports and are bus independent. With a simple software change, these output-only devices will print, using any code type-ball that will fit your machine.



Interface for Dura and Selectric.

The first interface, a basic isolator or level shifter, sells for $205. Print control and code conversion are completely software controlled. This provides a minimum cost isolator to protect your computer from high terminal voltages.

The second, a parallel interface, sells for $290. This device adds hardware print control to reduce software complexity and will interface to parallel ports with or without handshaking.

Both interfaces are delivered assembled and tested with case, postpaid in the continental U.S. California residents, please add tax.

Software driver example programs are included for 8080/Z-80 based systems with flowchart and documentation for easy conversion to other computers or different type-balls. This software has been checked out on, and is ready to run in, Digital Group Z-80 Maxi-BASIC, assembler and disassembler programs.

Sirius Micro Systems, 4490 Sirius Ave., Lompoc CA 93436.

Computer Kit Offered by RCA

A new, expandable, low-cost hobbyist computer kit, called COSMAC VIP (Video Interface Processor), is now available from RCA Solid State Division to permit the hobbyist to assemble a microcomputer with which to create and play video games, generate graphics and develop microprocessor control functions.

Priced at $275.00 in kit form, the VIP is a complete computer on a printed circuit card, offering a powerful, uncluttered, complete operating system in only 4K bits of ROM. VIP's output directly interfaces with a monochrome CRT display or, when used with an FCC-approved modulator, a TV receiver.

The heart of the VIP is RCA's CDP1802 microprocessor whose CMOS technology and 8-bit COSMAC architecture have established it in applications as varied as TV games, automotive engine controls and factory process controls.

The VIP features a single 8½ x 11" PC card with the CDP1802 microprocessor, 2048 byte RAM using 4K-bit static RAMs, single-chip graphic video display interface, built-in hexadecimal keyboard, 100-byte per second audio tape cassette interface, simple wall-plug regulated power supply, and easy expandability for both memory and I/O interfaces.

The CHIP-8 interpretive programming language simplifies the hobbyist's efforts in programming; video games can be stored in cassette tapes for ready use. CHIP-8 has 31 easy-to-use instructions in a 2-byte format.

The 512-byte ROM operating system offers the

hobbyist benefits in that it simplifies such tasks as loading a program into the RAM via the hexadecimal keyboard, recording RAM contents on cassette tapes, transferring tape-recorded programs into RAM, displaying memory bytes in hexadecimal format on a CRT, stepping through RAM contents, and examining contents of the CDP1802 CPU registers.

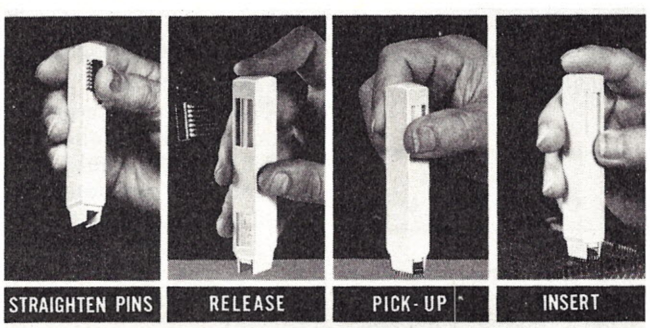
VIP is readily expandable, both on the PC card and through connectors. RAM capacity can be doubled on the card to 4096 bytes by adding four 4K-bit devices, and can be expanded to a total of 32K bytes by adding further memory capacity through a 44-pin connector socket in the card.

The hobbyist's manual contains detailed information on kit assembly, VIP operating procedures, CHIP-8 interpreter programming technique, machine language programming, logic description, test programs and troubleshooting guides, and VIP system expansion instructions.

RCA Solid State Division, Box 3200, Somerville NJ 08876.

DIP/IC Insertion Tool With Pin Straightener

The model INS-1416 DIP Insertion Tool inserts both 14- and 16-pin IC packages into sockets of predrilled boards. Durable glass-filled Lexan construction features precision parts and one-hand operation. Narrow profile permits tool to work on densely spaced patterns, while insertion mechanism assures accuracy. The tool also includes a pin straightener built into the handle. Simply insert the IC, rock it on the straightening saddle and push down on the tool. An automatic ejector delivers the IC ready to be placed in the insertion end for installation in your board or socket. OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.



OK's DIP/IC Tool.

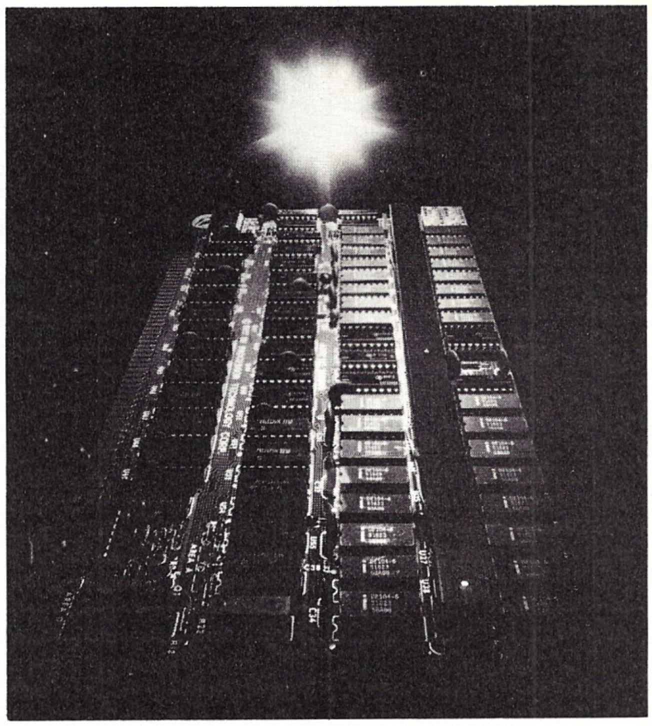
RO-CHE Multi Cassette Controller

RO-CHE Systems offers an I/O driver for BASIC with their Multi-Cassette Controller, which controls up to four recorders. This means that BASIC programs can read records from and write records to cassette tape under program control.

The I/O driver is patched to and from BASIC and handles all input and output to either the cassette operating system or the console.

The cassette operating system opens and closes files; even named files may be used. When a logical record is written the blanks are compressed out and the record is stored in a buffer. When the buffer is full the physical record is written to the cassette.

The Multi-Cassette Controller, which plugs into a single Tarbell interface board, comes in two models. The 4-port kit is $140 and the two-port kit is $110. Software consists of the cassette operating system, BASIC I/O driver and listing, assembler with patches to assemble large programs from tape, demo BASIC program and demo record file. RO-CHE Systems, 7101 Mammoth Ave., Van Nuys CA 91405.



16KRA Semikit.

Processor Technology Semikits

A 16KRA memory board in semikit form is offered by Processor Technology, manufacturer of small computers, peripheral equipment and software.

The new RAM board is the first in a series of memory modules in fully assembled and wave-soldered form with pretested ICs. At $369, semikits are priced competitively. The 16KRA board is also available fully assembled, tested and burned in for $399.

Features include a 16,384 byte memory, invisible refresh and worst-case access time of 400 nsec. Each 4096 word block is independently addressable for maximum system flexibility. Power is typically five Watts, the same as most single 4K memory modules. Backup power connection is built in.

Processor Technology Corporation, 6200 Hollis St., Emeryville CA 98608.

Computerlogue '77 Available

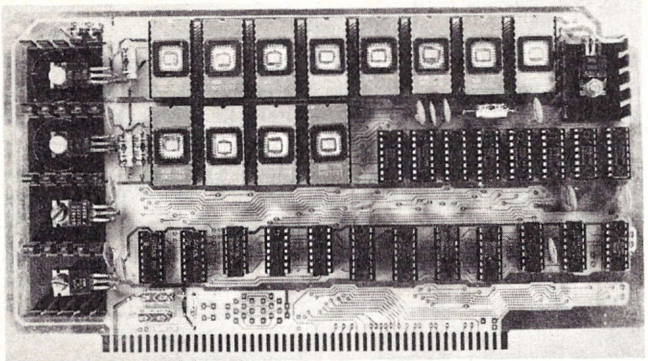
Computer Enterprises' first microcomputer catalog, called Computerlogue, is now available. The 22-page booklet contains products from all major manufacturers. So that a comparison can be made, retail price are given alongside cash-discount and credit-card prices. The cash price is the lowest price for each item listed.

Instructions on how to order are displayed inside the front cover.

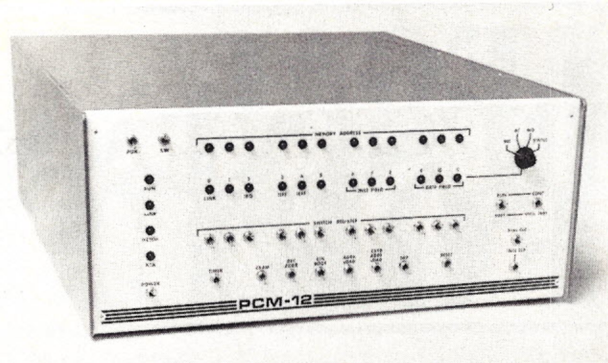
Computerlogue, PO Box 71, Fayetteville NY 13066 (315) 637-6208.

New PROM/RAM Board

Vector Graphic Inc. has a new PROM/RAM board with 1K on-board RAM and capacity for up to 12K 2708 type EPROMs. The board occupies two independently addressable 8K blocks. Complete addressing flexibility is pro-



New Vector Graphic board.



PCM-12 Microcomputer.

vided to conform to virtually any system configuration with a minimum of address jumpers required.

Price is $135 kit, $175 assembled. Vector Graphic Inc., 790 Hampshire Road A-B, Westlake Village CA 91361.

Heath Offers BASIC Course

Heath Company introduces its EC-1100 self-instruction course in BASIC language programming techniques. The course takes an approach that has been designed to teach even those with little or no computer experience the skills necessary to intelligently converse, create and program in BASIC.

Programmed instruction texts, practical demonstration programs and practice problems teach BASIC language formats, commands, statements and procedures. In addition, the course gives the student a practical introduction to the creative and problem-solving aspects of programming in BASIC. Mail-order priced at $29.95. Heath Company, Benton Harbor MI 49022.

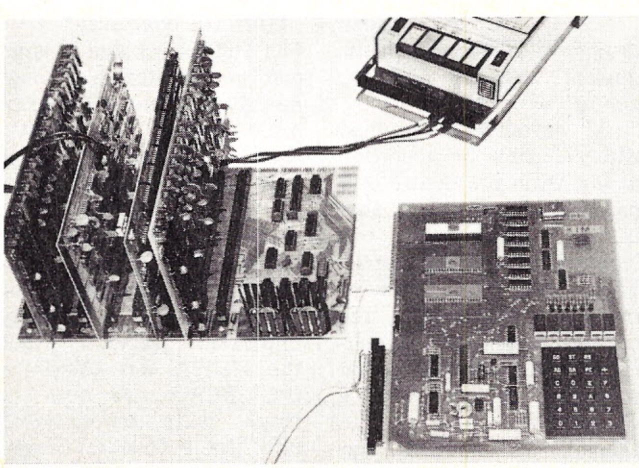
Plug-in S-100 Boards for KIM

Forethought Products' Kimsi is a new board that makes S-100 (Altair/Imsai) type boards *plug compatible* with KIM. The Kimsi board attaches to any KIM-1 computer, and on a single board provides both the interface logic *and* a fully buffered motherboard with eight 100-pin slots.

The ability to use currently available S-100 memory, video, I/O, PROM programming, graphics, and music and speech synthesis boards, etc., makes Kimsi an excellent base for a complete KIM system.

In use, Kimsi does not alter the operation of KIM in any way. Instructions are executed at full speed, and no extra instructions or software tricks are needed. The board includes complete address decoding and power regulation for KIM, and facilities for DMA and multiprocessing on the S-100 bus.

The Kimsi kit has a double-sided circuit board with soldermask and assembly/operating manual. Kit, $125; assembled, $165. Forethought Products, P.O. Box 386, Coburg OR 97401.



Kimsi board from Forethought.

PCM Micro is PDP-8 Software Compatible

Pacific Cyber/Metrix, Inc., has a 12-bit microcomputer system that is software-compatible with Digital Equipment Corp.'s PDP-8 family and sells for $989, or $679 in kit form.

Designated the PCM-12, the compact system incorporates Intersil's IM6100 12-bit CMOS Microprocessor and advanced MOS and low-power Schottky technology.

Because the IM6100's instruction set is identical to the PDP-8's, the PCM-12 user has access to the most extensive minicomputer software library available, from paper-tape assemblers and editors to high-level languages such as FORTRAN, BASIC, FOCAL and ALGOL, plus all operating systems for the PDP-8 family.

The PCM-12's basic price includes the 6100 processor; a memory system easily expandable to 32K; front-panel module with built-in bootstrap loader and control PROMs; power supply that typically consumes only 50 Watts; backplane bus structure; aluminum cabinet with slots for up to 15 plug-in modules; and a complete set of user manuals. PCM, 3120 Crow Canyon Road, San Ramon CA 95483.

Word Processing System

Interactive Data Systems has developed a word-processing system, IDSWORD1, designed to run under Mits Disk Extended BASIC. Some of the more important features of the system are:

Line editing – inserting, deleting or changing text in a line of data.

Global editing – inserting, deleting, changing or finding strings of data in a selected block of text.

Merging – combining portions of various files into a single file.

Reformatting – moving words between lines for maximum line size.

Moving text – moving or copying a selected block of lines from one place to another in the text.

Printing – text is printed with optional page numbering and right justification. User specifies left margin, spacing and maximum lines per page. Top and bottom margins are set automatically.

Form letters – multiple copies of a form letter, and mailing labels, may be

(continued on page 25)

LEGAL/ BUSINESS FORUM

Kenneth S. Widelitz
Attorney at Law

Caveat Emptor

Caveat emptor (let the buyer beware) seems to be the watchword when you purchase a product in the microcomputer market. It's ironic that such a high-technology industry has generated such a low level of confidence in its reliability. The situation reflects the stereotype of the microcomputer entrepreneur: a sophisticated engineer/technician, a naive businessman.

The computer hobbyist puts up with this state of affairs, rationalizing it with cliches: "Well, the industry is in its infancy. What can you expect when you're on the cutting edge of the second coming of the Industrial Revolution?" Yes, the cliches abound, as do the after-club-meeting war stories of dealings with some manufacturers and retailers in this industry. These tales run the gamut from stores charging customers for in-warranty service to manufacturers taking four months to repair a defective board. More often than not, those stories end with a sigh and a "What can you do?" or "That's life." NOT TRUE!

Recently enacted legislation has slain the doctrine of caveat emptor. Unfortunately, consumers, manufacturers and retailers have not read the obituary and are generally unaware of their rights and liabilities with regard to warranty.

This Forum will be the first in a series dealing with warranty. We'll start with an overview of warranty in general and a discussion of warranty legislation. This Forum will focus on implied warranties. The next Forum will examine express warranties and some of the new rules regarding warranty disclosure requirements, the pre-sale availability rule and the repair-facility requirements. This series plans to conclude with the results of a warranty survey that is being distributed to every retailer and manufacturer on the *Kilobaud* mailing list.

The Importance of Warranty

A study appearing in the *Journal of Marketing*, October 1968, by John Udell and Evan Anderson entitled "Product Warranty as an Element of Competitive Strategies" gives some insight into the importance of warranty. The study, which dealt mostly with large appliances such as refrigerators and dishwashers, found that a warranty is most effective as a method of competition when the buyer is dealing with a product that carries a high price tag, that is purchased infrequently, that he visualizes as being complex, and where a firm's share of the market is small. Clearly, each element exists in the microcomputer industry.

However, microcomputer manufacturers and retailers have given warranties short shrift. I've reviewed over a dozen warranties offered by microcomputer manufacturers. *None* conforms to the requirements of the recent legislation. A microcomputer manufacturer should give his warranty the same careful deliberation and consideration that he gives to the design of his product. A carefully considered warranty can do much to promote brand loyalty and accurately cost-out warranty liability. If a manufacturer costs-out his potential liability based upon assumptions that are not viable due to the requirements of the recent legislation, it might mean the difference between a profit or a loss year.

From the consumer's point of view, it is obvious that, as personal computing catches on, the purchaser of a microcomputer will have increasingly less technical expertise. It is logical that the less technically minded purchaser of a microcomputer will place a greater importance on the warranty than the engineer/hobbyist who finds it a challenge to get his system up and running. I think it is safe to say that the more money someone spends on an item, the more careful he is about what he purchases. It is also safe to say that most consumers perceive a close correlation between the cost of a product and the cost to repair it if it fails to function properly. It is conceivable that the warranty accompanying a product will be as important a consideration in the purchase of a microcomputer as the number of slots in the motherboard or the speed of an I/O device.

Types of Warranties

There are two broad categories of warranties: the implied warranty and the express warranty.

A warranty is implied when it arises by operation of law from the nature of a particular transaction; that is, it's automatic and requires no writing to arise. There are two kinds of implied warranties: the implied warranty of merchantability and the implied warranty of fitness for a particular purpose. In general, the implied warranty of merchantability means that a product must be free from defects in materials or workmanship. An implied warranty of fitness arises when the retailer, distributor or manufacturer has reason to know any particular purpose for which the product is required and that the buyer is relying on the skill and judgment of the seller to select and furnish suitable goods. The requisite knowledge and reliance can be implied. For example, if a manufacturer of a particular board advertises that it is Saltair/Bonzai compatible, there exists an implied warranty of fitness that the board can be used with such microcomputers.

The other type of warranty, the express warranty, is usually written. However, under the Uniform Commercial Code, the express warranty may be created by an oral affirmation of fact, i.e., when the retailer makes an oral statement as to the capability of a certain product. It should be noted that "puffing" does not create an express or implied warranty. That is, the retailer who says, "I guarantee your satisfaction," or that a particular product is "the best buy on the market" does not create a warranty.

Warranty Legislation

It was as late as 1975 that Congress enacted the first federal law relating to warranty. Officially called the Magnuson-Moss Warranty Act (MMWA), it is often referred to as the "Truth in Warranty" law. The MMWA is based in large part on California's Song-Beverly Consumer Warranty Act (SBCWA) of 1971. Although this law affects only California, I am going to go into parts of it in depth for a couple of reasons. One is that it goes beyond the requirements of the federal law in many important respects. Since the MMWA was based on the SBCWA, we may see those parts incorporated into the federal law eventually. Second, a good portion of the industry is

based in California and thus affected by that law. Third, I am familiar with the California law, so why not?

The oldest legislation relating to warranty is the Uniform Commercial Code (UCC). Almost every state has its own version of the UCC, but, as its name implies, they are all substantially similar. The UCC is a creature of the mid-sixties.

It should be noted that the MMWA and SBCWA are *consumer*-protection oriented. The products covered are *consumer* goods or products, which are defined as items normally bought for personal, family or household purposes. Thus, home or hobby computers are certainly covered. The House Report on the MMWA indicates that products that are in fact used for business purposes fall within the ambit of the law if the products are generally used for personal, family or household purposes. I can see arguing that microcomputers used in business would be covered by the MMWA.

Implied Warranties

Implied warranties are created by provisions in the UCC and the SBCWA. While the MMWA does not create any implied warranties, it does legislate the extent to which they can be limited.

You will be relieved to know that if you sell a product only casually, such as your used microcomputer and peripherals, no implied warranties arise.

The implied warranty of merchantability is a retailer's warranty under the UCC. Under the SBCWA it is a liability of the manufacturer.

The implied warranty of fitness under the UCC is also a retailer's warranty, whereas under the SBCWA it is made by both the manufacturer and the retailer.

While the UCC does not set the duration of implied warranties ("reasonable" length), the SBCWA specifically states that the duration of an implied warranty is coextensive with that of any express warranty that accompanies the product. However, in no event shall the implied warranty be for a period of less than two months or for a period of more than one year. If no written warranty is provided, the duration of the implied warranty is one year under the SBCWA.

Before the enactment of SBCWA, the implied warranties created by the UCC were relatively easy to disclaim. We have all seen clauses in warranties stating: "This warranty is made in lieu of all other warranties expressed or implied . . . ." As a result of the enactment of the SBCWA, that disclaimer is ineffective. Under the SBCWA, the only way the implied warranties can be disclaimed is by a sale's being made on an "as is" basis. A conspicuous writing indicating an "as is" sale attached to the product sold is required. Any other attempted waiver of any implied warranty is *void.* Remember, the SBCWA only applies in California.

The remedies available to the consumer under the SBCWA and the UCC for the breach of an implied warranty are identical, with the single exception that the SBCWA specifically provides that if a consumer sues based upon the breach of an implied warranty, the consumer may recover his attorney's fees.

Damages that a buyer may recover are incidental damages and consequential damages. Incidental damages include the cost of repairing a defective product and other costs, such as the transportation of the goods to and from the place where they are repaired. Consequential damages include such damage, loss or injury as does not flow directly and immediately from the breach of the implied warranty, but only from some of the consequences or results of such breach.

For instance, take the case of an amateur radio operator who hires a typist to input data relating to all the contacts he made in 1976. Let's say because of a defect in the cassette interface he is using, none of the data is recorded. The consequential damages would be equal to the amount he spent to hire the typist.

Of course, it may not be economically feasible for the hobbyist to pursue his legal remedies. But consider that the small-claims action is inexpensive. It can be more of a hassle for the manufacturer or retailer than you. And the manufacturer or retailer who loses such a case will be more sensitive to similar problems in the future.

Warrantor of the Month

Warranty experiences aren't always nightmares. My only experience to date leads me to nominate the Byte Shop of Tarzana as the first "Warrantor of the Month." My Imsai didn't work when I completed it. Two long evenings of troubleshooting with my mentors couldn't solve the problem. So the front-panel board went back to where I bought it. *Two days* later, I got a call telling me the problem was solved: the board hadn't been etched perfectly and two traces had shorted. Four days later I was down again. This time I got my "fixed" call the *next* day: a bad chip this time. Thanks, fellas.

Any other nominations? Comments to:

Kilobaud Legal/Business Forum
10960 Wilshire Blvd.
Los Angeles CA 90024

THE BASIC FORUM

John Arnold/Dick Whipple

We sit down to begin this month's BASIC Forum at a desk piled high with letters from readers of our column!

Responses to May Forum

In the May Forum, we carried several letters from readers describing modifications and additions to BASIC. We have since published letters from readers commenting on the proposed changes. John Bockelmann, an electronics teacher at Tenafly (NJ) High School has the following comment about one of the changes:

"I am writing in response to Erik Brown's letter in the May issue. Erik wants to assign the I/O ports under program control. MITS 12K BASIC (version 3.2) already has this ability. The command CONSOLE followed by a decimal integer from 0 to 255 will change the I/O to the port thus defined. If we say:

```
100 CONSOLE 200
```

BASIC will respond by setting the control port to 200 decimal and the data port to 201.

"This feature could be useful in many game-type programs, like Battleship, where each player could have his own console and wouldn't be able to see what the other player entered. The console command also works in the direct mode to transfer control to a second terminal.

"We have done a great deal of experimenting with BASIC's special features and always read your column with interest. Before long, we will have BASIC running through a monitor for its I/O and will have it interfaced to a floppy-disk system."

Another reference to May's Forum came from Randall Thomas, 12103

Gary Hill Dr., Fairfax VA 22030, a high-school student. His own computer is a Poly 88, but at school he has access to a Hewlett-Packard 2000. Unfortunately, Randall's letter is too long to publish. In it he clearly expresses his enthusiasm for H-P BASIC. We must admit that some of the features he describes would be welcome additions to our micro software. The last paragraph of his letter summarizes his thoughts.

"Needless to say, we have a considerable system in school (with Tape, Disk and Card Reader I/O), and it is quite a comedown to program my Poly after a taste of this! (If only I could teach it a few things!)"

Jim Caldwell, one of our regular readers and correspondents, dropped us a note about the formation of a users' group to be known as the International Users' Group for the 6800 Microprocessor. Jim is a contributor to their newsletter, *FIFO*, and we understand the first issue contains his clever word-processing program written in BASIC. You can get more details about the group by writing International Computer Center Director, Post Office Drawer 2790, Norman OK 73070.

Solutions for September's Programming Problem

We've already mentioned the pile of letters – well, it seems that the little programming problem in the September issue stirred lots of interest among our readers; the response was overwhelming! Our main concern has been to think of a way to acknowledge the many contributions made by our readers. Since it would be impossible to publish all the letters and program listings, we were forced to: 1. choose a few representative letters to publish in entirety and 2. summarize details of the rest in an accompanying table.

The problem as stated was to write a program that would generate a list of prime numbers between 1 and some value, N. We asked our readers to submit their solution program plus certain pertinent data for the case N=1000. Most respondents used one of two techniques for solving the problem: The first we shall refer to as the *division method*, and the second as the *sieve method*. The division method is the most obvious and straightforward, although it has the potential of being horribly inefficient and time-consuming if done improperly. In the fundamental division method, each value within the range 1 to N is divided by a predetermined sequence of numbers. If the full sequence is used without an even division, that value is labeled a prime number and printed out; otherwise, the program moves on to the next value. We will permit our readers to pick up the discussion at this point. From Robert Hinkley, 350 W. 55 St., NYC 10019:

"I have enclosed my program for determining the prime numbers between 1 and N (inclusive). Since I don't have my own computer yet, I asked the Computer Store & Computer Mart in NYC to try it out. Using N=1000, the processing part of the program (excluding printing) took just under 60 seconds on an Altair 8800 using Mits BASIC version 4.0, and about 80 seconds on an Imsai 8080 using North Star BASIC version 6-FPB.

The program is based on the following facts about prime numbers:

1. 1, 2, 3, & 5 are known primes.
2. No even number above 2 is a prime.
3. Any number not a prime is divisible by a prime.
4. Let X be a number not divisible by prime P or by any prime lower than P. Then if X/P is less than the next prime higher than P, X itself must be a prime.

"I thought my solution procedure was efficient; so I was disappointed that it took so long to process. I'll be interested to read about any programs you've received that run faster." (See Program A.)

Robert A. Calbridge, Jr., 106 N. Dorothy Dr., Richardson TX 75081, writes:

"In response to your problem in issue No. 9, I enclose my solution.

"By cutting corners, i.e., using constants, and eliminating all even numbers from the test field, I have been able to bring the time to 1 minute and 15 seconds. I fudged the first three numbers in order to orient the initial values for the best time. Elimination of all even values of A (by step 2), cut the time considerably. By applying the same fact to the prime test division by B, it eliminated more unnecessary work.

"Furthermore, allowing a division test by only numbers up to the square

```
LIST
5 DIM P(300)
10 PRINT "THIS PROGRAM DETERMINES & LISTS ALL"
20 PRINT "THE PRIME NUMBERS FROM 1 TO N"
30 PRINT "WHAT SHALL N BE";
40 INPUT N
50 IF N>1 THEN 90
60 PRINT "TRY AGAIN, N MUST BE 1 OR MORE"
70 GOTO 30
90 P(1)=1
100 L=1
110 IF N<2 THEN 320
120 P(2)=2
130 L=2
140 IF N<3 THEN 320
150 P(3)=3
160 L=3
170 IF N<5 THEN 320
180 P(4)=5
190 L=4
200 I=5
210 I=I+2
220 IF I>N THEN 320
230 J=3
240 X=I/P(J)
250 IF X=INT(X) THEN 210
260 IF X<P(J+1) THEN 290
270 J=J+1
280 GOTO 240
290 L=L+1
300 P(L)=I
310 GOTO 210
320 PRINT "ALL PRIMES HAVE BEEN DETERMINED"
330 PRINT "THERE ARE ",L," FROM 1 TO",N
340 PRINT "LIST THEM (Y,N)";
350 INPUT A$
360 IF A$="N" THEN 400
370 FOR I=1 TO L
380 PRINT P(I);
390 NEXT I
392 PRINT
400 PRINT "WANT TO DO ANOTHER (Y,N)";
410 INPUT A$
420 IF A$="Y" THEN 30
430 END
READY
```

```
1  2  3  5  7  11  13  17  19  23  29  31  37  41  43  47  53  59  61  67  71  73
79  83  89  97  101  103  107  109  113  127  131  137  139  149  151  157
163  167  173  179  181  191  193  197  199  211  223  227  229  233  239  241
251  257  263  269  271  277  281  283  293  307  311  313  317  331  337  347
349  353  359  367  373  379  383  389  397  401  409  419  421  431  433  439
443  449  457  461  463  467  479  487  491  499  503  509  521  523  541  547
557  563  569  571  577  587  593  599  601  607  613  617  619  631  641  643
647  653  659  661  673  677  683  691  701  709  719  727  733  739  743  751
757  761  769  773  787  797  809  811  821  823  827  829  839  853  857  859
863  877  881  883  887  907  911  919  929  937  941  947  953  967  971  977
983  991  997
```

Program A.

Name	Computer and/or Software	Method	Time	Notes
1. Robert A. Calbridge, Jr 106 N. Dorothy Dr. Richardson TX 75081	Processor Tech. 5K BASIC	Division	100+ s	Very efficient coding. See listing above.
2. Ronald Anderson	SWTP	Division	100+ s	Very thorough development
3 3540 Sturbridge Ct. Ann Arbor MI 48105	8K BASIC	Sieve	100+ s	of solution. Wish there was room to print it!
Milan D. Chepko, M.D. 119 Belleville Ct. Thief River Falls MN 56701	Morrow Micro Stuff 8080A	Sieve	94 s	Used Denver Tiny BASIC. He dusted off some old textbooks researching this one.
4. Tom Dowling 58 Wannalancit St. Lowell MA 01854	Tektronik 4051	Division	97 s	Sent excellent documentation.
	Same	Sieve	28 s	Program fast but requires lots of storage.
	Same	Sieve	88 s	Written following rules for "structured" programming.
5. Bill Duemling 15897 Marentette Mt. Clemens MI 48043	Mits Disk BASIC 4.1	Division	65 s	Well-written code.
	CDC 6500 BASIC Complier	Division	35 s	Actual RUN time much less – as stated, includes print out.
6. Robert Hinkley 350 W. 55th St. NY NY 10019	Mits Disk BASIC 4.0	Division	60 s	See letter above.
	North Star BASIC 6-FPB	Division	80 s	
7. Verlynn J. Johnson RFD 2 Storm Lake IA 50588	Digital Group Maxi-BASIC	Division	100+ s	"That little quiz at the end of . . . Forum was a brilliant idea! I enjoyed the challenge!"
	Same	Sieve	18 s	"What BASIC needs is bit addressing . . . I am using 5-byte variables to store one bit's worth of information." Good point!
	Digital Group Tiny BASIC (TBX)	Sieve	43 s	Slowed by lack of STEP command.
8. J. W. McGaw Box 3874 Nellis AFB NV 89191	POLY 88 A00 BASIC	Sieve	12 s	John's sieve program is not substantially different, but he worked hard to minimize RUN time. See letter.
9. David Meltzer 5194 E. Oxford Ave. Englewood CA 80110	Digital Group Maxi-BASIC	Sieve	30 s	See complete letter.
10. John R. Pierce PO Box 579 Pacific Grove CA 93950	Intel MDS-800 BASIC-E	Sieve	59.5 s	John's MDS system sounds terrific!
11. David Shuman 1989 Altamont Pl. San Diego CA 92139	SWTP 6800 8K BASIC	Division	100+ s	His was the first entry received.
12. Webb Simmons 1559 Alcala Pl. San Diego CA 92111	Home-brew Z-80	Division	100+ s	Webb borrowed time on a friend's machine – the HP-97 is his present toy.
	HP-97 (Prog. Calculator)	Division	100+ s	Would you believe 21 hours?
	HP-97	Sieve	100+ s	
13. Charles Sisco 1438 Buena Vista Springdale AR 72764	Mits Disk BASIC 4.1	Division	73 s	Used no arrays. Primes printed as found.
14. Gary Tack PO Box 866 Corrales NM 87048	Mits BASIC Ver. 3.1	Division	64 s	Used arrays.
15. Jeff Teeters 1720 Coolage Ct. Eau Clair WI 54701	Burroughs B-5500 BASIC Compiler	Division	2.9 s	That's fast! Jeff gives us an idea of the software generation gap.
16. Anne Weiss 1 Winthrop Rd. Somerset NJ 08873	Processor Tec. Sol 20 BASIC 5	Division	100+ s	Of interest here is that Anne merely changed 3 lines in her division program to obtain one of the faster sieve programs.
	Same	Sieve	25 s	
17. Bob Wilson, III 39597 Benavente Pl Fremont CA 94538	Mits 12K Ext. BASIC	Sieve	33 s	The same program was RUN in both BASICs.
	Processor Tech. 5K BASIC	Sieve	37.5 s	

Table 1.

root of the number under test eliminated more work.

"The value assigned to C is only a flag to signal the program that an integer was the result of a division by B. If C is set to 1, then A is not prime and the value of A is not printed. A is then incremented, C is preset, and A is then sequentially tested by all possible integers (odd ones that is) until either the value of C is set by an integral quotient or all possible values have been tried with no result, and the number is printed.

"I used Processor Technology 5K BASIC output through a VDM-1." (See Program B.)

```
 5 PRINT "1 2 3",
10 FOR A=3 TO 1000 STEP 2
15 C=O
17 D=SQR(A)
20 FOR B=3 TO D STEP 2
22 E=A/B
30 IF E=INT(E) THEN C=1;B=D
50 NEXT B
60 IF C=1 THEN GOTO 80
65 PRINT A,
80 NEXT A
```

Program B.

The sieve method originated in antiquity with the Greek mathematician Eratosthenes. It is truly the more elegant approach, although some might be tempted to classify it as first-class trickery! With the sieve method, no division is ever used – in fact, no arithmetic at all is needed. "How so," you ask? Let's give our readers a chance to explain:

"My name is David Meltzer [5194 E. Oxford Ave., Englewood CA 80110] and I am going into ninth grade.

"Last year in school, I learned an algorithm called a sieve for finding prime numbers. This method involves writing down numbers from 2 to X (1 not being included because it is neither prime nor composite). Now, the first number on the list (2) is noted. Next, all the multiples of 2 are scratched out, then the next number on the list not scratched out (3) is noted as a prime, also, and its multiples are scratched out. The next number not scratched out is 5, and so on.

"I have duplicated this process by having the computer remember which numbers are scratched out (will be given a value of 1) and which numbers are not (will be given a value of 0). The variable for the array that keeps track of the numbers 2 through X and remembers which ones are scratched out is F. To cut the time of this process in half, we know that the only even prime is 2. Thus we only need to make a list of the odd numbers in addition to 2 (which I print separately in line 80). The computer divides the input number (N) in half (variable H in line 20) to know how many odd numbers there are up to N (excluding 1). Before the sifting begins, the array (F) is cleared to 0 (lines 40 to 60).

"The actual sieve process is from lines 90 to 160. Line 90 initializes a loop from 3 to N. Not all of these numbers are generated; only the odd ones are because of STEP 2. Line 110 checks if the present loop number is scratched out already. If so, it fetches the next odd number. If not, it prints it out as a prime number and then proceeds to line 130, which initializes the loop that scratches out (sets the value to 1) all the multiples of that prime up to N.

```
1 REM *** THIS PROGRAM FINDS PRIME ***
2 REM *** NUMBERS BETWEEN 2 AND N ***
3 REM *** USING THE SIEVE METHOD. ***
4 REM *** WRITTEN BY DAVID MELTZER ***
5 REM *** FOR THE BASIC FORUM. ***
10 INPUT"2 THROUGH ?",N
20 H=INT(N/2):IF N/2=INT(N/2) THEN H=H-1
30 DIM F(H)
40 FOR Z=1 TO H
50 F(Z)=0
60 NEXT Z
70 X=0
80 PRINT"2";
90 FOR L=3 TO N STEP 2
100 X=X+1
110 IF F(X)>0 THEN 160
120 PRINT L;
130 FOR Z=X TO H STEP L
140 F (Z)=1
150 NEXT Z
160 NEXT L
170 END
```

Program C.

"When the program is run on our computer (Digital Grup Z-80 with Z-80 Maxi-BASIC), it takes about 30 seconds." (See Program C.)

Our last letter is from TSgt. John McGaw, Box 3874, Nellis AFB NV 89191:

"I decided to try your little programming problem. The best solution I could develop in an afternoon is this. (See Program D.)

```
1000 INPUT "LIMIT? ",Q\I=1\DIM A(Q)\N=SQRT(Q)
1010 I=I+1\IF A(I)=1 THEN 1010 ELSE IF I=>N THEN 1050
1020 FOR J=2*I TO Q STEP I\A(J)=1\NEXT\GOTO 1010
1050 FOR K=1 TO Q\IF A(K)=0 THEN PRINT K,CHR$(9),
1060 NEXT\STOP
```

Program D.

"This program minimizes operations that execute slowly in most interpreters (math) and concentrates instead on comparing and indexing. It creates a set of flags (A) used to mark all non-prime numbers and proceeds through the list of values from 1 to the preset limit, marking off every 2, 3, 5, 7, n value as non-prime. This looping goes on until n is equal to or greater than the square root of the preset limit. At the end of the calculations, the program prints all numbers that have not been flagged, in eight columns across the terminal screen.

"Calculation times for limit=1000 have been running around 11.5 to 11.8 seconds.

"My system is a Poly 88, with 32K RAM, 7K ROM, K.C. tape, 9600-baud home-brew tape, and a home-brew analog subsystem. I/O is presently limited to the Poly video system and a keyboard, but an I/O Selectric is in the works. . . .

"My BASIC interpreter is Poly version A00. . . ."

In Table 1 we have attempted to summarize the information received from those who sent solutions. We had some misgivings about unrestricted publishing of the RUN times because of the misunderstanding that might arise. The wide variation in these figures was caused as much by differences in code and algorithmic efficiency as by interpreter differences. As a sort of editorial compromise, we decided to give exact timings only for those solutions that ran in under 100 seconds. Even so, readers should not use the timing data to draw conclusions about the respective speed of any BASIC represented.

Based on the data in the table, we are led to conclude that the sieve method is generally faster than the division method. The sieve method, on the other hand, requires a lot of storage, while the division method does not. Wonder what Eratosthenes would have thought about all this?

Thanks to all who sent in solutions. Your response has encouraged us to make the program problem of the month a regular feature – which brings us to this month's challenge:

Write a program to find all

(continued on page 26)

LETTERS

The Computerized Doctor's Office

I was turned on to *Kilobaud* at Electronic Specialty Company here in Houston as a good, down-to-earth introduction to the hardware and hardware/software interface of small computers – particularly the "Kilobaud Klassroom." I used to speak fluent FORTRAN and PL/1 in college but know that to understand the mind one must understand the brain; so enclosed is my check for a subscription to *Kilobaud*. I've already done the first two Klassrooms with a friend and am looking forward to the third and fourth.

I have a pipe dream about using an Imsai with an LSI 11 processor in an on-line time-sharing setup for patient/computer, secretary/computer, nurse/computer, patient/doctor/computer interactive programs to handle patient information, past history, review of systems, family history, stress score, health-risk survey, accounting, medical record formatting, disease and drug cross-indexing, success-of-treatment evaluation, prescription printing, recalls and lab data. I would like someone to invent a printer that could hold several forms at once and feed them independently. It would have to have type as opposed to 5x7 matrix for readability. The alternative is several printers, and they tend to be expensive. I was intrigued by the possibility of using an IBM Selectric II such as this for input/output.

My only gripe about your editing is that the columns in the front of *Kilobaud* skip around too much. How about just printing them in blocks so I don't have to keep jumping back and forth? Also, as I still understand very little initialese, would you please at least spell out your abbreviations the first time you use them in an article? I've also been hearing a lot about bubble memory. Could you write an article on how it works, what is in the future, and when?

Thanks for an information-packed, relevant journal. Keep up the good work.

James H. Phelan, MD
Kingwood TX

The pipe dream sounds just great, Jim. Now all you have to do is stop thinking about it and do something about it. I'm sure you must realize that just the drug cross-indexing you mentioned would require a large chunk of time to transfer it from the reference books into the computer. The same could probably be said for most of the ideas you mentioned (both software development and simple transfer of data). What you need to do is form an association or users' group with other doctors having your interests (and capabilities) and have each person develop a particular module for this entire package. Not only would the finished product be something of great value in your everyday work, but you could also make some bucks selling the package to other doctors (hmmm . . .). A good way to get something like this started is with a letter to the editor.

I always try to ensure that acronyms are used only after they've been defined, because I feel the same way you do.

As to bubble memory – read David Huss's article, "Magnetic Bubble Memory," in the November issue. – John.

Bring in the Kids!

A year ago today, we took possession of our small computer, an IBM 5100. It was purchased for business applications, but it has become a part of our family activities as well. We have just subscribed to *Kilobaud* and, after reading two issues, I am writing to: 1. propose that you regularly include some information geared to young children and 2. explain this proposal through our experience.

When we purchased our computer, my husband and I were the only employees in the firm with any computer experience. This meant that we had to do the installation – primarily after office hours. The initial installation of the computer, software modifications, and data input meant that our children (ages 5 and 6) became accustomed to seeing one or both parents working at the "'puter."

The children were intrigued, and we began inviting them to use the computer. Under our guidance, they learned to use the keyboard to input data, to add, write sentences, make designs and print what was on the video screen.

The next step for the children was games. My brother wrote a ticktacktoe game for the girls to play; other simple games were added to the "fun tape" as time permitted.

In recent months, the girls have become curious about how the computer works. I have looked for introductory programming books and materials but find little information geared to the elementary-age group.

Kilobaud could provide some of this information in at least two ways that I can think of:

1. Include a regular feature for the children in the magazine. This would use simple language and graphic presentation of how a computer works, exercises to introduce the BASIC vocabulary, etc.
2. Prepare a series of lessons printed for use by the parent, working with the child. Again, simple, short explanations and exercises would be used.

Regardless of the approach, I am convinced that children can become familiar with computers, their usefulness and fascination at an early age. They will be prepared to use computers effectively as their knowledge becomes more complex.

Why not have computers as a family hobby? It's fun and fascinating!

Linda Williams
Nitro WV

I couldn't agree with you more, Linda. Sounds like a fantastic idea. As a matter of fact, I have just the right person in mind for the job. – John.

Let's Hear It for the Wired OR!

The wired OR comment by Tim Barry (*Kilobaud*, September 1977, p. 157) is misleading in suggesting it should be avoided or is somehow bad practice. Also Barry's circuit shows three separate pullup resistors when only one is required, which hints that Barry has not studied this problem in much detail. Irrespective of what we call it, wire ORing is a powerful method for reducing circuit complexity, eliminating ICs and even simplifying circuit-board layout. It is used in many commercial systems, most notably KIM-1, where the lower 8K address decoding is all wired OR circuitry. Even if Barry doesn't think much of the wired OR, 7500 or more KIM systems attest to its utility, and I have never heard of anyone's having trouble with this particular example.

Don Lancaster in his *CMOS Cookbook* calls one version Mickey Mouse Logic (M2L) when used as the diode-wire OR with CMOS. Similarly, Motorola's *MCMOS Handbook* has a whole section illustrating diode ORing alternative

gating methods. The use of diode OR-AND methods is very common in thumbwheel-switch preset gating where it often simplifies circuit layout because the isolating diodes provide crossover jumpers for single-sided PC boards. I have used up to 12 diodes with a single common anode pullup resistor in a three-decade BCD preset counter. In another application where open collectors are not available as in the 74LS138 three-to-eight decoder, diode-isolated outputs may be wire ORed (or ANDed) together to combine output as desired with the proper choice of pullup resistor.

In short, wire ORing, when properly applied, is easy to use, not difficult to troubleshoot and is here to stay. Excellent performance is obtained with CMOS and 74LS ICs when used with isolating diodes where open collectors are not available.

Ralph W. Burhans
Athens, Ohio

Once in a great while Tim goofs. This was one of those rare occasions. – John.

"Circuits" Section in KB?

I found the "Faster MIKBUG Load Technique" (KB No. 9) very interesting. Unfortunately, only the assembler listing was given. I think the learning process as well as implementation would surely have been enhanced had the address and instruction code been listed to the left of the labels. As I recall, a famous editor once wrote: "Remember that there are as many hardware types reading *KB* as there are software people . . . . In other words, we need to try and provide as much material possible to make the article as comprehensive as possible."

Before I climb off the soapbox, just a few more items. Please *do* continue to list all the articles and features on the cover. (I wish *73* would consider doing that.) Also, would you consider a software equivalent to the *73* "Circuits" feature? I envision this to be a one-to-five-line program feature (not restricted, I hope, to BASIC) giving just the essence of an idea without long explanations (see Example 1).

Thanks for considering my proposals. Good luck!!

Richard Wright
Tiffin OH

You got me on that one, Richard. The machine-language code should have been included in those listings. (By the way, who was the "famous editor?" Sounds like a brilliant fellow!)

We've had several requests for a "Circuits" section in Kilobaud *. . . and I like the idea . . . so let's do it. Rather than limiting it to software or hardware, why don't we make it for both? We'll see if we can come up with a catchy name for it, but in the meantime . . . send 'em in. We'll accept contributions for small efforts or send you the book of your choice (from the* KB *Book Nook) for more extensive efforts. (You indicate which you want it to be – a contribution or a book.) Should turn out to be a nice way to share many of those hardware and software tips and techniques we run across almost daily. – John.*

```
10 PRINT CHR$ (16); CHR$ (22);
SWTP 8K BASIC, home up & erase
```

Example 1

Who's Using Math?

One of the good points about the hobbyist field in computers is that you don't need much more than a willingness to learn and lots of patience to get started. But since I have an advanced degree in math and eight years' experience as a college teacher, I find myself wondering what role mathematics plays: Is it necessary to the growth and development of the average hobbyist, and if so how much of what kind? I am not necessarily limiting myself to the traditional curriculum.

In short, I am attempting to find out what computer hobbyists are doing (or not doing) with math, preferably specific examples. Is there some situation where a little mathematical know-how did help or could have helped?

I would like to hear from people concerning this. I am preparing a questionnaire that includes a generous amount of space for comment on what is, what ought to be, or even on how stupid it is to fill out questionnaires! I welcome any kind of response, including insults, as long as they are in good taste.

Bennett Sawey
318 N. Maple St., #16
Truth or Consequences NM
87901

A 360 Replacement?

I am employed by a denominational agency. We are investigating word processors and minicomputers.

Our file in our (IBM-360) service bureau has about 9000 records. In addition to the reports produced by the service bureau, we would like to do special mailings.

We would need permanent storage for a name-address file, a nine-track tape drive compatible with our service bureau, a CPU capable of sorts and calculations and an easily edited typewriter-face printer.

I have written a few programs in COBOL (NYU computer courses) and I am now programming our Monroe 1830 calculator-writer. I believe I could quickly pick up BASIC or other minicomputer languages.

I would appreciate any information you could send.

John England
The Ministers and
Missionaries Benefit Board,
American Baptist Churches
475 Riverside Drive
New York NY 10027

I would be willing to bet there are some individuals among our readers who would be interested in discussing such an undertaking with you in greater detail. – John.

Alpha Digital Systems . . . OK

Since I believe it is just as important for your readers to know about the good companies as well as the poor, I would like to take this opportunity to commend the excellent service offered by Alpha Digital Systems of Boone NC. Not only does Joe Howell offer completely assembled systems at *kit* prices, but his service is personal, concerned, rapid and dependable. He stands behind what he sells. **** (four stars) for him and your great magazine. Thanks.

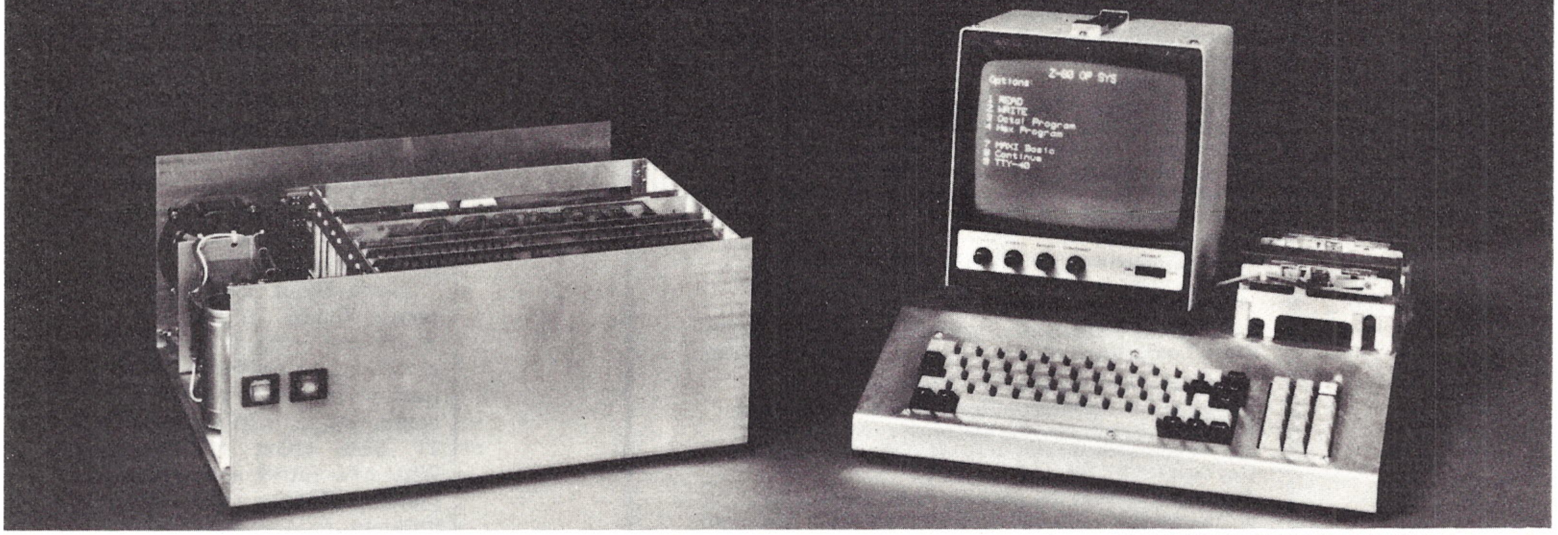
Steven O. Russo
Ithaca NY

Computer Portraits – A Real Money Maker!

Please accept my compliments for a very fine selection of software articles in your past issues. However, I would like to see more application programs in FORTRAN and APL. The Microsoft people have recently released a 12K version of 8080 FORTRAN, and an APL interpreter will be available in the near future.

The floppy ROM was born in the May 1977 issue of *Interface Age.* A small vinyl record coded with 6800 4K BASIC was inserted into every issue of the magazine. Still in the experimental stage, perhaps, but it might just catch on. An 8080 disassembler in floppy ROM might make a

Up your organization.



The Basic Box (left) and the Peripheral Plate.

With no-nonsense organizers from the Digital Group.

Not so long ago, the microcomputer domain belonged to a special group of creative, inventive folks — the inveterate hardware hackers who delighted in making a thing work and didn't really care all that much about how it looked.

The Digital Group was a part of it. Our original microprocessor systems were designed not to require any cabinets at all — they simply worked well.

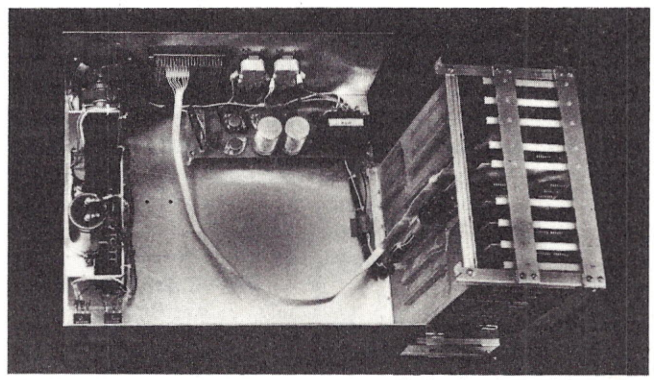
Of course, along the line we couldn't resist making a good thing look good too . . . and we added our complete line of custom, deluxe cabinets to cover up.

Well, we haven't forgotten those no-nonsense computer builders who just want a way to organize their systems. So the Digital Group has taken a step back to come up with a basic answer: The Organizers — the *Basic Box* and the *Peripheral Plate*.

Beautifully simple. No paint. No anodizing. No frills. Just exactly what you need.

The Basic Box houses your CPU, power supplies, fan, switches and I/O connectors in one tight little 16" by 17" package. It's available completely naked — a metal box with a card rack so you can add to it from your own parts supply; or we'll spiff it up for you with optional equipment.

The Peripheral Plate is a piece of bent metal with room for your keyboard, video monitor, two Phi-decks or an audio cassette recorder. All at your fingertips. For organization.



Card rack swings out for service.

Naturally, our basics have down-to-earth prices, too. The Peripheral Plate is a mere $19.50 . . . the basic Basic Box goes for $45 (a little more depending on options).

Want to up your organization? It's simple. Just call or write the Digital Group for details.

the digital group

P.O. Box 6528 • Denver, Colorado 80206
(303) 777-7133

good start.

Another practical application of particular interest to me is computer portraits. I hear they're a potential money-maker. I think it's about time the six-million-dollar toy started earning its own keep.

Anyhow, thanks for your time and keep up the good work!

Ken Wong
Edmonton, Alberta
Canada

Undoubtedly we will be seeing FORTRAN, and perhaps APL, within the hobbyist community to a significant degree within the next few years. But . . . don't count on seeing a lot of FORTRAN programs in KB *until there is evidence that this shift has begun (ditto for APL).*

I like the floppy ROM idea . . . we'll have to see how it works out with regard to reliability and acceptance as time goes by. In the meantime, count me as one of the supporters, OK?

Computer portraits . . . oh, boy! What a moneymaker those systems are! I had a promise of an article on such a system some time ago . . . but it fell through. The commercial versions of those systems sell for around $24,000. I'd be willing to bet a hobbyist could make one for between $7K and $10K. – John.

BASIC Arc Sine and Arc Cosine

The privately owned small computer is often programmed with BASIC, and for that reason magazine articles are appearing that contain listings of various BASIC programs. One of the persistent errors I have noticed has to do with the inverse trig functions "arc sine" and "arc cosine," which are incorrectly assumed to be unavailable in BASIC. This leads to the unnecessary use of mathematical approximations that take up valuable memory space.

Every form of BASIC I have used can calculate the arc tangent, and this function is all that is needed to get the other two inverse trig functions. In fact, that's why "arc sine" and "arc cosine" were left out of BASIC in the first place.

1. To get "arc sin X" in radians, use
   ATN(X/SQR(1-X**2))
2. To get "arc cos X" in radians, use
   ATN(SQR(1-X**2)/X)
   when X is between 0 and 1
3. To get "arc cos X" in radians, use
   355/113+ATN(SQR(1-X**2)/X)
   when X is negative (note that 355/113 is a very close approximation to pi).

Example 1.

The three BASIC statements in Example 1 illustrate my point. These equations give the smallest angle that has the value X for its sine or cosine, and they are exact, as any high-school trig student should be able to prove. A simple IF statement will allow the automatic selection of case 2 or 3, depending upon X.

Richard Slater
Export PA

What's Happening?

Having just finished the September *Kilobaud*, I have further appreciation of the magazine and the variety of articles in it. I depend on it for keeping up to date on the micro industry, and have been examining its pages in search of a micro for my own use.

How about an annual survey similar to the one when the magazine first came out, showing the leaders in production of computers. Is Mits still No. 1? How about SWTPC? What new entries are on the field? (Thanks for the write-up on the new PET. I'm one who likes to build my own from a kit, but the economics of the PET made me take a hard look first.) Is the S-100 bus a shoo-in or are there some serious challengers? Is the Digital Group's philosophy of interchangeable CPU boards catching on? How about some information on the various buses – IEEE-488, S-100, SWTPC, Digital Group – so we can be figuring on the practicality of adapter boards between the various ones.

I appreciate knowing about the various industries (ref. article on Seals Electronics), their size, quality and design philosophy, etc. Also, I use your magazine to keep up on all the product ads and who has what for how much. The notices for the computer shows and

club information are very useful. I hope to see something on the bubble memories soon! Keep it coming.

John Nierste
Clio MI

PS. My biggest complaint is that the mailing wrapper was glued to the front cover!

Thank you, John. You have some interesting and thought-provoking points there. Who is selling the most systems today? And, yes, we could use some articles comparing and pointing out the features, faults and different boards being built for various buses (although I'm not sure we'd have room to list all the S-100 boards). – John.

NEW PRODUCTS

(from page 15)

printed from name and address files.

Price is $250. Interactive Data Systems, P.O. Box 290, Owings Mills MD 21117.

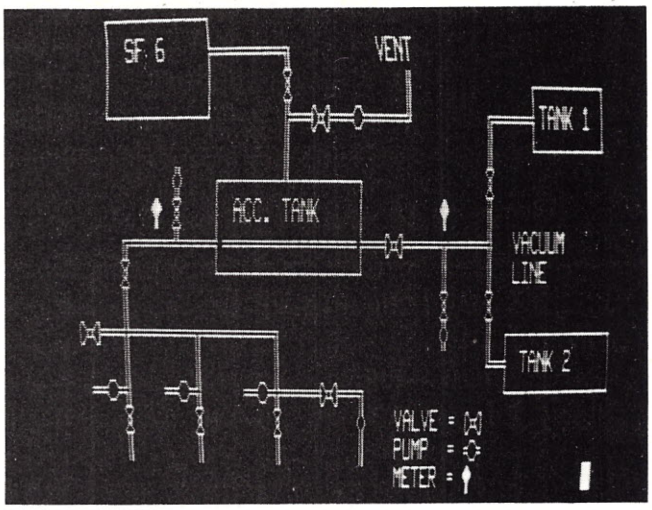
Programs for KIM-1

The First Book of KIM is a collection of dozens of programs – some useful, some recreational, all tested and documented – to run on the Commodore KIM-1 system. Also included is a beginner's guide and other information useful to current and prospective KIM owners. ORB, PO Box 311, Argonne IL 60439.

Programmable Character Generator

Objective Design's new S-100 card adds the ability to dynamically create the characters generated by a video display device. For those who require special mathematical or scientific symbols, APL characters, sub and superscripts, high-density bar graphs, Greek letters, or game characters such as spaceships, the Programmable Character Generator allows the creation and storage of the new character while retaining the original character set intact. Keyboard interface and dual joystick interfaces are provided on the board.

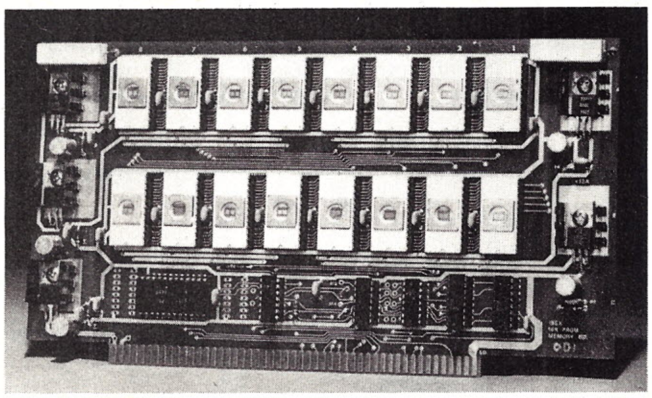
Objective Design, Inc., PO Box 20325, Tallahassee FL 32304.



Programmable Character Generator output.

16K EPROM Memory Board Kit

Designed to plug into the popular S-100 bus, the Ibex memory board holds 16 2708 EPROMs. Unused 4K sections can be disabled to allow RAM to exist within the board's address space. The board also has provisions for a wait state to allow it to run on a Z-80 system. The kit comes complete with sockets for all ICs (less EPROMs) for $85. Ibex, 1010 Morse Ave., Suite 5, Sunnyvale CA 94086.

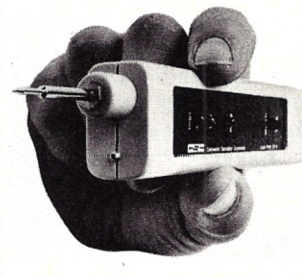


Ibex 16K EPROM memory board.

CSC Introduces Multifamily Logic Probe 2

The Multifamily Logic Probe 2 (LP-2) adds to CSC's expanding line of prototyping and test equipment. A price of $24.95 brings it within reach of hobbyists, as well as making it ideal for industrial applications in production testing, field service, etc.

Drawing its power from the circuit under test, LP-2 provides pulse detection and pulse stretching functions for an instant readout of logic levels, positive and negative transitions, pulse symmetry (duty cycle), as well as abnormal circuit conditions.



Multifamily Logic Probe 2.

Logic Probe 2 can be used to check all types of digital circuits, including clocks, gates, registers, counters, ALUs, I/O ports, UARTs, CPUs, etc. Continental Specialties Corporation, 44 Kendall Street, Box 1942, New Haven CT 06509.

BOOKS

(from page 9)

of course. A lengthy technical treatment would certainly be out of place. But without even a passing mention of these technical aspects in the book, the computer novice must inevitably miss some perspective. There are already too many black-box myths surrounding computers.

Similarly, the capabilities of Mits BASIC to do certain pseudo machine-language instructions are ignored. Functions such as PEEK and POKE (reading and writing bytes to specific memory locations), and OUT (sending bytes to I/O ports) are not even mentioned. The ability to call machine-language subrou-

tines (USR) is not discussed in the text (though it is listed in one table of functions).

Generally, the explanations are complete and lucid. Only two obvious mistakes were noticed (an inconsistent description of the SGN function and a typo involving a missing variable in the explanation of the ON . . . GOTO statement). For some reason, the RESTORE (resetting data pointer) and CLEAR (resetting string space) statements are not mentioned.

Examples are frequent and helpful. Many useful small programs are included, which should germinate new ideas in the reader. The text is also sprinkled with programming tips that should prove to be valuable for the beginner.

In short, this book is a winner. For those fluent in another high-level language (like FORTRAN or COBOL), a reference manual on BASIC is more to your need. But for those without much programming experience, this is an excellent tutorial for BASIC and elementary programming concepts. The care, effort and imagination that Brown has infused into this book should be well worth the price of admission.

Phil Feldman
Los Angeles CA

Game Playing with BASIC
Donald D. Spencer
Hayden Books
Rochelle Park NJ, $6.95

This book starts off with a short introduction in the first chapter to computers and how they can be used in game playing. There is a section telling the reader how to write game programs, and then there are some samples for him to try.

The second chapter covers the fundamentals of BASIC. After that, it's on to some simple games in chapter three.

Subsequent chapters deal with "Number Recreations," "Gambling Games" (such as Slot Machines, Blackjack, Baccarat and Wheel of Fortune), "Puzzles" and "Magic Squares."

The book concludes with a lot of games for reader solution.

Game Playing with BASIC will keep you, your family and friends busy for a long time.

PUBLISHER'S REMARKS

(from page 5)

for such a low-cost mail system . . . and during the day, the one-minute rate runs about 40 cents via WATS line, so it is quite reasonable as an instant mail system for business. That beats telegrams and even the telephone because you pay less, take less executive time and have hard copy if you want it.

Let's get busy with this and start one of the real big revolutions in microcomputer applications.

THE BASIC FORUM

(from page 20)

three-digit numbers for which the sum of the cube of the digits is equal to the number.

Send your solutions along to BASIC Forum at the address given below.

A Further Look at Iterative Techniques

Last month, we discussed iterative techniques in an introductory way. We now want to look at a more detailed application. Most analytical functions in mathematics can be calculated by the use of power series. Consider the trigonometric function sine, for example. Its power series representation is given in Example 1 for all real values of x. The more terms retained in the calculation, the more accurate we would expect this representation to be. In case you are not familiar with the meaning of 3!, 5!, etc., these are called factorials. For zero and the positive integers, the factorials are given below.

0! = 1 (by definition)
1! = 1
2! = 2•1 = 2
3! = 3•2•1 = 6
4! = 4•3•2•1 - 24
. . . .
N! = n(n-1)•(n-2) . . . . 2•1

Suppose we are asked to write a program to approximate sine of X using the first four terms of the series. We would probably start with the most obvious approach and write the short program in Example 2.

Line 20 simply reproduces the first four terms of the series. Actually, there is nothing wrong with this approach, except perhaps its lack of generality. For instance, suppose we wished now to take the first eight terms instead of four. We would have to work out the additional four terms and add them in line 20. Expanding to many more than 8 terms will make line 20 awkwardly long and perhaps even force it to be split into two separate lines. What a mess!

With a little thought, we can develop an iterative technique that will allow us to change the number of terms by entering a single value. Consider the program in Example 3.

The variable Y is the current value of the Ith term in the series. The trick used here is quite simple. Each new term is evaluated using the value of the previous term (see line 60). The value of the new term is added to S in line 70, thus accumulating in S the sine of X. The FOR-NEXT loop controls the number of terms added. The generalization is worth the effort. We can now ask for 4, 8, 12 or most any number of terms without changing the program.

So you can try your hand at creating an iterative program, the series for cosine is given in Example 4.

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots$$

Example 1.

```
10 INPUT X
20 Y=X-X↑3/6+X↑5/120-X↑7/5040
30 PRINT Y
40 GOTO 10
```

Example 2.

```
10 INPUT "NUMBER OF TERMS";N
20 INPUT "X=";X
30 S=X; Y=X
40 IF N<2 THEN 90
50 FOR I=3 TO 2*N-1 STEP 2
60 Y= -X*X*Y/(I*(I-1))
70 S=S+Y
80 NEXT I
90 PRINT"SIN(X)="S
100 GOTO 10
```

Example 3.

$$\cos(X) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots$$

Example 4.

Next month: Round Off Error in BASIC.

Letters should be addressed to: The BASIC Forum, P.O. Box 7082, Tyler TX 75711.

EDITOR'S REMARKS

(from page 6)

Bryant. Take a look at some of the ads and flyers coming out of the Digital Group and you'll notice their new cassette operating system, PHIMON. David Bryant wrote it.

The moral: Look to your local high schools. Instructors and students alike will welcome you with open arms.

Swap Meet — Rescheduled

Last month, I mentioned that I would be putting together, with Art Childs, another swap meet for the Southern California area on December 10th. We're going to have to put that little project on the back burner right now and reschedule it for sometime next year. And, the more I think about it, George Young is probably responsible for this change in plans. You see, George wrote an article for Issue No. 8 (August) on how to write for *Kilobaud* ("Sooo, You Want to be an Author!"). The magazine hit the stands about the first of July. A month later (August) and on into September (when this is being written) I am being deluged with manuscripts! I haven't decided whether I should shoot myself for running this article . . . or him, for doing such a good job on it!

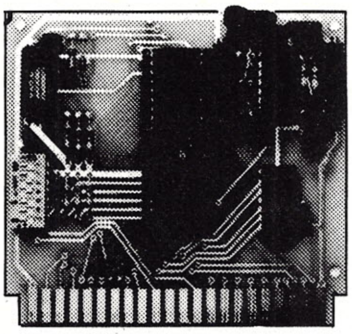
The article has been responsible for a lot of people sitting down and writing about what they're doing . . . and I'm certainly not complaining. I just decided I'd better get manuscripts processed so you can enjoy them, rather than devoting energy and time to a swap meet right now.

"The Colonel" Begins His Extended "Vacation"

On September 22, "Colonel David Winthrop" (Norman Hunt) was sentenced to two years and eight months for grand theft and fraud in connection with his activities as head of DataSync Corporation. It is expected that the state of Texas will initiate extradition procedures and take him back there to face trial on a bad-check charge and several others. Therefore, it's very likely he'll step out of a California state prison into a Texas state prison. When he's through in Texas, there's a good chance a federal prison will be waiting for him (and they're much nicer than state joints) because the U.S. Postal Service is bringing mail-fraud charges in connection with his DataSync ads. Good-bye, Dave. We ain't gonna miss ya.

ELECTRONIC SYSTEMS
p.o. box 212 Burlingame CA
(408) 374-5984

E21

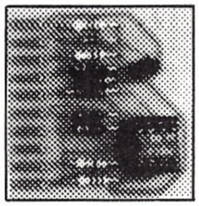


UART & BAUD RATE GENERATOR

Part no. 101

• Converts serial to parallel and parallel to serial
• Low cost on board baud rate generator
• Baud rates: 110, 150, 300, 600, 1200, and 2400
• Low power drain +5 volts and -12 volts required
• TTL compatible
• All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity.
• All connections go to a 44 pin gold plated edge connector
• Board only $12.00; with parts $35.00

RS-232/TTL INTERFACE



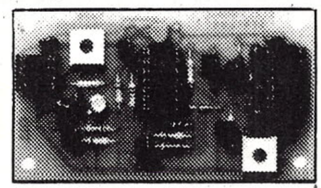
Part no. 232

• Converts TTL to RS-232, and converts RS-232 to TTL
• Two separate circuits
• Requires +5 and -12 volts
• All connections go to a 10 pin gold plated edge connector
• Board only $4.50; with parts $6.00

DC POWER SUPPLY

Part no. 6085

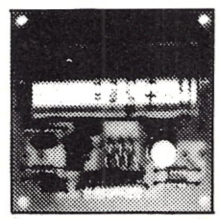
• Board supplies a regulated +5 volts at 3 amps., +12,-12, and -5 volts at 1 amp.
• Board has filters, rectifiers, and regulators
• Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps.
• Board only $12.50



TAPE INTERFACE

Part no. 111

• Play and record Kansas City Standard tapes
• Converts a low cost tape recorder to a digital recorder
• Works up to 300 baud
• Digital in and out are TTL
• Output of board connects to mic. in of recorder
• Earphone of recorder connects to input on board
• Requires +5 volts, low power drain
• Board $7.60; with parts $19.95
• No coils



Part no. 107

RF MODULATOR

• Converts video to AM modulated RF, Channels 2 or 3
• Power required is 12 volts AC C.T., or +5 volts DC
• Board $4.50; with parts $13.50

VISA master charge

To Order:

Mention part number and description. For parts kits add "A" to part number. Shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. Dealer inquiries invited. 24 Hour Order Line: (408) 374-5984.

Don Lancaster
Synergetics

TVT Hardware Design

. . . Part 1: instruction decoder and scan

Don Lancaster will soon have a new book released by Howard W. Sams called The Cheap Video Cookbook. *The following is the first of a two-part series, taken from the book, and is an elaboration on the hardware design that went into the TVT-6L. The TVT-6L is an entirely new concept in low-cost video displays that was originally presented in the June 1977 issue of* Kilobaud. *– John.*

An interface card has to hold most of the dedicated circuitry needed between a microprocessor and a TV set. You'll find a block diagram of a typical card shown in Fig. 1. Depending on its design details, you can use this type of card with graphics, alphanumerics or a combination of the two.

The *instruction decoder* is the central controller of a microprocessor-based video display. It's usually a small bipolar PROM. When activated by the scan program, the instruction decoder decides when a scan of video is needed and what video is going to be produced. Control signals are delivered to the rest of the interface circuitry by the instruction decoder. These signals include sync pulses and disabling signals that go back to make sure nothing else tries to use the microcomputer at the same instant that the TVT needs it.

The *scan microprogram* generator is a second PROM that outputs a scan microinstruction to the microprocessor. This PROM is activated by the instruction decoder every time a scan of video is wanted.

The *data-to-video converter* is usually a dot-matrix character-generator integrated circuit for alphanumeric use, and is usually a shift register or a shift-register and data-selector combination for graphics use. This converter block converts code stored in the computer's display memory and received by way of the new upstream tap into serial video you can display. (The upstream tap is a point in the memory between the memory ICs and the data bus drivers, i.e., "raw" memory output.) The instruction decoder controls the data-to-video converter by telling it which row of dots to output on a character or which part of a word to output for a graphics format.

High Frequency Timing controls the serial-video dot output and rate. This block can be a hex inverter gated oscillator driven from the microcomputer's main clock. A *cursor* circuit may also crop up in alphanumeric TVTs. The cursor introduces the winking underline or box that shows us the next character location. The cursor circuit usually is made up of a low-frequency oscillator and some gating.

The *sync and position* block takes horizontal and vertical timing signals from the instruction decoder. It then delays these timing signals as needed for positioning. After this, it goes on to shape these sync commands into the proper time widths for TV use.

Our *video output circuitry* combines video and sync and then provides a composite output suitable for monitor, rf modulator or direct television video interface. One important part of the output circuitry is the *bandwidth enhancer*. This simple compensation circuit is usually

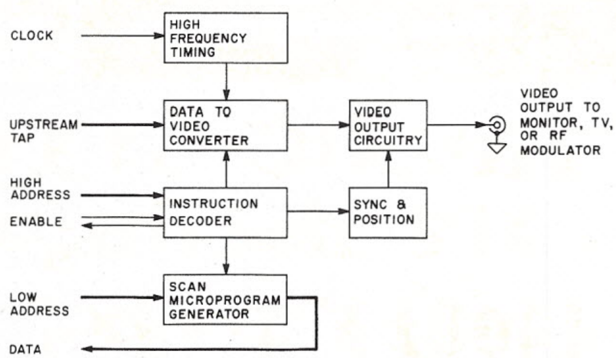


Fig. 1. Block diagram of typical interface hardware.

The

INSTRUCTION
DECODER

must:

* Activate the scan microprogram when a scan is needed.
* Disable everything else trying to use the computer CPU when a scan is needed.
* Select the right graphics format or alphanumeric dot row.
* Output sync pulses as needed.
* Otherwise not interfere with normal computer operation.

Fig. 2. The Instruction Decoder PROM is the key controlling block of the interface hardware.

included to predistort the output video in anticipation of how the TV set will try to mess it up. The result is denser, sharper characters for a given TV's bandwidth, and is one of the keys to displaying long character lines on an ordinary TV set.

Let's take a closer look at these interface hardware blocks and see just what is involved in their design and use.

Instruction Decoder

Our instruction decoder PROM is the control center for TVT use of a microprocessor. The important functions of the instruction decoder are summarized in Fig. 2. It has to tell the microprocessor when to generate a scan of characters or graphics chunks, and it has to pick the right part of whatever you are going to display. Furthermore it has to firmly take over command of the microcomputer when the TVT is in use. When not in use, the instruction decoder has to make the interface hardware appear invisible to normal computer operation.

A 256-bit bipolar PROM of 32 words of eight bits each is a good choice as an instruction decoder. This is the smallest PROM you can buy, costing under $2. Important advantages of using a PROM for the instruction decoder are the flexibility of assigning what each address does, the ease of changes, and the single-IC simplicity of board layout.

Fig. 3 shows one good way to use a 32 x 8 PROM as an instruction decoder. We input high-order address lines A15, A14, A13 and, optionally, A12. We use A12 when we need 16 total instructions. We can omit A12 when eight or fewer instructions will do the job.

There are eight output leads available. One of these is used for a *decode enable* that takes over command from the computer's normal address decoding. On a KIM this is line KO, and is low for normal computer use and high for TVT use. A second output is a chip select command that goes low when we want to activate the display memory as far as the upstream tap. A third output drives our SCAN microprogram generator, going low to produce a scan microinstruction. Two sync outputs are needed, both horizontal and vertical. Often the *decode enable* output can double as a horizontal sync output, saving us a pin.

The remaining four output lines can be used to format the output data. In alphanumerics, these can be the

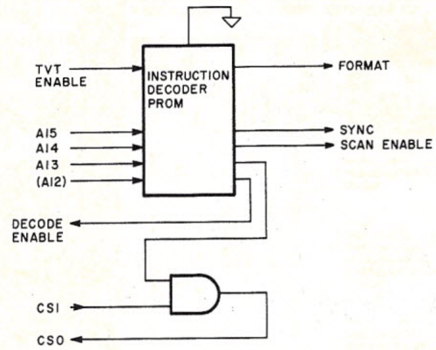


Fig. 3. Instruction Decoder PROM using external gate for display memory chip select. This allows other, non-TVT, uses of high-order address lines.

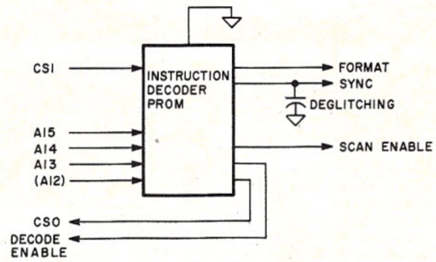


Fig. 4. Instruction Decoder PROM, with internal gating for display memory chip select. This saves a gate but produces output glitches and reserves most high-order addresses for exclusive TVT uses.

INPUTS				OUTPUTS							
				Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1
	WORD #	WHAT DOES THIS WORD DO ?	HEX OP-CODE	CS OUT	SCAN ENABLE	DECODE ENABLE	VERT SYNC	CG LINE "8"	CG LINE "4"	CG LINE "2"	CG LINE "1"
NORMAL CHIP SELECT	0	NORMAL	4Ø	□	■	□	□	□	□	□	□
	1	NORMAL	4Ø	□	■	□	□	□	□	□	□
	2	BLANK SCAN	2Ø	□	□	■	□	□	□	□	□
	3	LINE 1 SCAN	21	□	□	■	□	□	□	□	■
	4	LINE 2 SCAN	22	□	□	■	□	□	□	■	□
	5	LINE 3 SCAN	23	□	□	■	□	□	□	■	■
	6	LINE 4 SCAN	24	□	□	■	□	□	■	□	□
	7	LINE 5 SCAN	25	□	□	■	□	□	■	□	■
	8	LINE 6 SCAN	26	□	□	■	□	□	■	■	□
	9	LINE 7 SCAN	27	□	□	■	□	□	■	■	■
	10	LINE 8 SCAN	28	□	□	■	□	■	□	□	□
	11	LINE 9 SCAN	29	□	□	■	□	■	□	□	■
	12	LINE 10 SCAN	2A	□	□	■	□	■	□	■	□
	13	LINE 11 SCAN	2b	□	□	■	□	■	□	■	■
	14	VERTICAL SYNC	5Ø	□	■	□	■	□	□	□	□
	15	NORMAL	4Ø	□	■	□	□	□	□	□	□
TVT CHIP SELECT	16	NORMAL	CØ	■	■	□	□	□	□	□	□
	17	NORMAL	CØ	■	■	□	□	□	□	□	□
	18	BLANK SCAN	2Ø	□	□	■	□	□	□	□	□
	19	LINE 1 SCAN	21	□	□	■	□	□	□	□	■
	20	LINE 2 SCAN	22	□	□	■	□	□	□	■	□
	21	LINE 3 SCAN	23	□	□	■	□	□	□	■	■
	22	LINE 4 SCAN	24	□	□	■	□	□	■	□	□
	23	LINE 5 SCAN	25	□	□	■	□	□	■	□	■
	24	LINE 6 SCAN	26	□	□	■	□	□	■	■	□
	25	LINE 7 SCAN	27	□	□	■	□	□	■	■	■
	26	LINE 8 SCAN	28	□	□	■	□	■	□	□	□
	27	LINE 9 SCAN	29	□	□	■	□	■	□	□	■
	28	LINE 10 SCAN	2A	□	□	■	□	■	□	■	□
	29	LINE 11 SCAN	2B	□	□	■	□	■	□	■	■
	30	VERTICAL SYNC	dØ	■	■	□	■	□	□	□	□
	31	NORMAL	CØ	■	■	□	□	□	□	□	□

6L-D12
PROM NUMBER

□ = "0"
■ = "1"
(POSITIVE LOGIC)

USE FOR TUT-6L
12 DOT LINE
ALPHANUMERIC
SCANS.

Fig. 5a. Truth table for Alphanumeric Decode PROM 6L-D12.

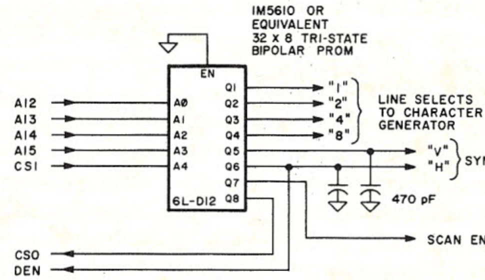


Fig. 5b. Connections for Alphanumeric Decode PROM 6L-D12.

TVT	WORD #	WHAT DOES THIS WORD DO ?	HEX OP-CODE	Q8 CS OUT	Q7 SCAN ENABLE	Q6 DECODE ENABLE	Q5 V SYNC	Q4 LOWER SELECT	Q3 BLANK	Q2 SPARE	Q1 SPARE
TVT ENABLED	0	NORMAL	4Ø	□	■	□	□	□	□	□	□
	1	"	4Ø	□	■	□	□	□	□	□	□
	2	"	4Ø	□	■	□	□	□	□	□	□
	3	BLANK SCAN	2Ø	□	□	■	□	□	□	□	□
	4	LOWER CHUNK SCAN	2C	□	□	■	□	■	■	□	□
	5	UPPER CHUNK SCAN	24	□	□	■	□	□	■	□	□
	6	VERTICAL SYNC	5Ø	□	■	□	■	□	□	□	□
	7	NORMAL	2Ø	□	■	□	□	□	□	□	□
	8	"	CØ	■	■	□	□	□	□	□	□
	9	"	CØ	■	■	□	□	□	□	□	□
	10	"	CØ	■	■	□	□	□	□	□	□
	11	BLANK SCAN	AØ	■	□	■	□	□	□	□	□
	12	LOWER CHUNK SCAN	2C	□	□	■	□	■	■	□	□
	13	UPPER CHUNK SCAN	24	□	□	■	□	□	■	□	□
	14	VERTICAL SYNC	dØ	■	■	□	■	□	□	□	□
	15	NORMAL	CØ	■	■	□	□	□	□	□	□
TVT DISABLED	16	"	4Ø	□	■	□	□	□	□	□	□
	17	"	4Ø	□	■	□	□	□	□	□	□
	18	"	4Ø	□	■	□	□	□	□	□	□
	19	"	4Ø	□	■	□	□	□	□	□	□
	20	"	4Ø	□	■	□	□	□	□	□	□
	21	"	4Ø	□	■	□	□	□	□	□	□
	22	"	4Ø	□	■	□	□	□	□	□	□
	23	"	4Ø	□	■	□	□	□	□	□	□
	24	"	CØ	■	■	□	□	□	□	□	□
	25	"	CØ	■	■	□	□	□	□	□	□
	26	"	CØ	■	■	□	□	□	□	□	□
	27	"	CØ	■	■	□	□	□	□	□	□
	28	"	CØ	■	■	□	□	□	□	□	□
	29	"	CØ	■	■	□	□	□	□	□	□
	30	"	CØ	■	■	□	□	□	□	□	□
	31	"	CØ	■	■	□	□	□	□	□	□

7-G PROM NUMBER
□ = "0"
■ = "1"
(POSITIVE LOGIC)

USE FOR TVT-7 GRAPHICS SCANS.

Fig. 6a. Truth table for Graphics Decode PROM 7-G.

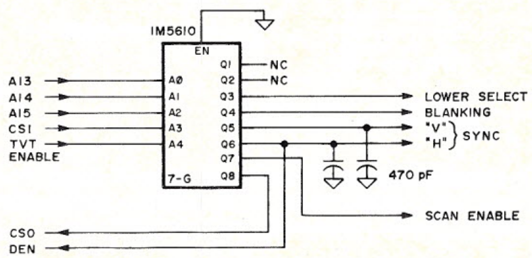


Fig. 6b. Connections for Graphics Decode PROM 7-G.

The

SCAN MICROPROGRAM GENERATOR

must:

* Generate the right coding to sequentially scan a row of video.
* Optionally provide for alphanumeric memory repacking.
* Be transparent during other computer uses.

Fig. 7. The Scan PROM generates the long microinstruction needed to sequentially output a row of characters or graphics dots.

three or four "what line is it?" row commands that go to the character generator. For graphics, we can use a blanking output and an upper/lower output.

Our 32 x 8 PROM has a fifth input. We can pick just what we are going to do with it. In Fig. 3 we've used an external AND gate to combine the normal computer chip select with the TVT chip select to provide a composite CSO that activates the display memory as needed. This external gate is physically an AND gate and is shown with its usual positive logic symbol, but in reality it is used as an "either input low gives a low output," or as its DeMorgan equivalent OR gate.

We can call our fifth PROM input a *TVT enable* and activate it from some external logic. This lets you use the higher-order memory slots for other things besides TVT use. Letting the TVT enable low will let the TVT work; when it is high, the TVT remains inactive and the computer is free to do whatever else it wants with its high address lines. For all-the-time TVT use, simply ground this input.

Note that we have to keep our instruction decoder outputs active at all times to prevent messing up the decode enable commands. This usually means that the PROM's own enable input must stay grounded at all times. Thus, we must switch our PROM outputs from an active to a passive state as far as TVT operation is concerned; but we must never actually float the Tri-state outputs.

We also have the option of using our fifth PROM address input as a display memory chip select input *from* the computer. This internalizes the AND gate used for the chip selects as shown in Fig. 4. We did this on the TVT-6L (*Kilobaud* No. 6, June 77) as part of the mania for doing an entire video display in only six integrated circuits. There are two penalties to pay when you use internal display memory CS selection. One is that your outputs glitch, which means you have to crudely filter the sync outputs. The second is that you can't use many of the higher address locations for anything but TVT use.

Fig. 5a is the truth table for an alphanumeric instruction decoder having an internal chip select. This is the PROM used on the TVT-6L. Locations 0-15 are selected if the decoder is to pass through an existing low CSI. Locations 16-31 are selected if the TVT is only to provide its own CSO when needed to the display memory. The only output difference you'll see between these two halves of the truth table is the CSO output itself.

The remaining inputs are driven from A12 through A15 and select normal computer operation, a blank scan, a vertical sync pulse or scan of lines one through eleven. Outputs include the four character-generator line commands, the vertical sync output, the scan enable for the microprogram generator, the decode enable for the computer and the chip select output for the display memory. Typical connections are shown in Fig. 5b.

Your turn: Show a truth table for a similar alphanumeric PROM whose fifth input is a TVT enable line. Show how external logic can switch between TVT operation and other use of high-order address slots.

A graphics decode truth table that is used on the TVT-7 is shown in Fig. 6a, along with its typical connections in Fig. 6b. Only eight input address decodings are necessary, so A12 is no longer needed. This frees two PROM inputs; one is used as a CSI chip select input and the second as a TVT enable line.

Scan Microprogram Generator

The *scan microprogram generator* is a second PROM used as part of our interface hardware. Its purpose is to force a SCAN instruction onto the microprocessor. The microprocessor, in turn, gives us a sequential one-character-per-microsecond code output that lasts for as many characters or chunks as you want in a horizontal line. Fig. 7 sums up what our scan microprogram generator has to do.

To produce a scan, a scan software program calls a subroutine at an address that activates the instruction decoder. The instruction decoder then activates the scan microprogram generator, which produces the microcode needed for a sequential scan. For the 6502, coding

	Word #	What does this word do ?	Hex op-code	Q8 DB7	Q7 DB6	Q6 DB5	Q5 DB4	Q4 DB3	Q3 DB2	Q2 DB1	Q1 DBØ
NOT USED FOR 32 CHARACTER LINES	0	LDY	AØ	■	□	■	□	□	□	□	□
	1	"	AØ	■	□	■	□	□	□	□	□
	2	"	AØ	■	□	■	□	□	□	□	□
	3	"	AØ	■	□	■	□	□	□	□	□
	4	"	AØ	■	□	■	□	□	□	□	□
	5	"	AØ	■	□	■	□	□	□	□	□
	6	"	AØ	■	□	■	□	□	□	□	□
	7	"	AØ	■	□	■	□	□	□	□	□
	8	"	AØ	■	□	■	□	□	□	□	□
	9	"	AØ	■	□	■	□	□	□	□	□
	10	"	AØ	■	□	■	□	□	□	□	□
	11	"	AØ	■	□	■	□	□	□	□	□
	12	"	AØ	■	□	■	□	□	□	□	□
	13	"	AØ	■	□	■	□	□	□	□	□
	14	"	AØ	■	□	■	□	□	□	□	□
	15	"	AØ	■	□	■	□	□	□	□	□
USED FOR ALL LINE LENGTHS	16	"	AØ	■	□	■	□	□	□	□	□
	17	"	AØ	■	□	■	□	□	□	□	□
	18	"	AØ	■	□	■	□	□	□	□	□
	19	"	AØ	■	□	■	□	□	□	□	□
	20	"	AØ	■	□	■	□	□	□	□	□
	21	"	AØ	■	□	■	□	□	□	□	□
	22	"	AØ	■	□	■	□	□	□	□	□
	23	"	AØ	■	□	■	□	□	□	□	□
	24	"	AØ	■	□	■	□	□	□	□	□
	25	"	AØ	■	□	■	□	□	□	□	□
	26	"	AØ	■	□	■	□	□	□	□	□
	27	"	AØ	■	□	■	□	□	□	□	□
	28	"	AØ	■	□	■	□	□	□	□	□
	29	"	AØ	■	□	■	□	□	□	□	□
	30	"	AØ	■	□	■	□	□	□	□	□
	31	RTS	6Ø	□	■	■	□	□	□	□	□

6L-S64
PROM NUMBER
□ = "0"
■ = "1"
(POSITIVE LOGIC)

6502 CODING

USE FOR:
ALPHANUMERIC SCANS
• 32 CHARACTER LINES
• 64 CHARACTER LINES
• OTHER LINES THAT ARE NOT REPACKED

GRAPHIC SCANS
• 8/1 B/W
• 4/2 B/W
• 3/2 COLOR

Fig. 8a. Truth table for Scan PROM 6L-S64.

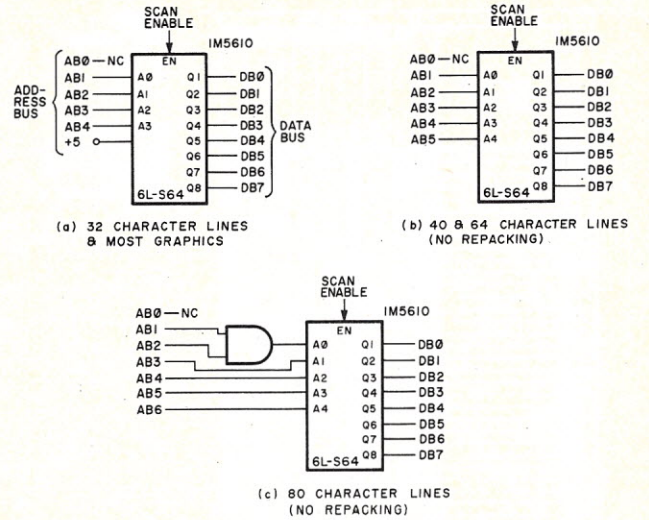


Fig. 8b. Connections for Scan PROM 6L-S64. Scan enable input comes from instruction decoder.

can be a sequence of LDY commands followed by an RTS.

When a scan is wanted, the instruction decoder provides a ground on its scan enable output line. This ground is used to activate the Tri-state PROM that generates our scan microinstruction.

Once it is activated, this PROM takes over control of the computer's data bus. When not activated, the Tri-state outputs float and remain transparent to the data bus. This lets your computer behave normally during non-scan times. When you are scanning, it is very important that anything else that might want to use the data bus is disabled — this is what the DEN output on the instruction decoder is for. This output disables everything but the scan microprogram PROM when a scan is needed. The DEN output goes low for normal computer use and high for scan microprogram use.

Typical coding for a universal scan microprogram PROM is shown in Fig. 8a. Our code consists of 31 LDY commands followed by a single RTS. By ignoring address AO, we double this capability to get 62 microseconds' worth of "Load Y with the command for Load Y," followed by two microseconds' worth of advancing RTS.

This PROM coding can be used anywhere you want a scan of most any length, so long as memory repacking is not needed. Some typical connections appear in Fig. 8b. With input A4 positive, we can scan 32 or fewer characters per line. Any even number of characters is possible, but the packing density drops as you use fewer characters. This PROM is used in the TVT-6L for 32 alphanumeric characters, and in the TVT-7 for 32 chunks that result in 96, 128 or 256 horizontal graphics dots.

If all five inputs are used, we pick up a 34 to 64 character-per-line capability. This includes densely packed 64-character lines and non-repacked 40-character lines. Finally, if we add an external AND gate, we can go from 68 to 128 characters per line to pick up an 80-character, non-repacked ability. Line lengths with this gate must be some multiple of four.

Your turn: Show the PROM connections and memory map for densely packed lines of 8 and 16 characters.

Note that this PROM must have Tri-state outputs, since it's absolutely essential to float the outputs going to the data bus during non-TVT times. Note further that your coding will change with your change in microprocessor family.

	Word #	What does this word do ?	Hex op-code	Q8 DB7	Q7 DB6	Q6 DB5	Q5 DB4	Q4 DB3	Q3 DB2	Q2 DB1	Q1 DB0
	0		AØ	■	□	■	□	□	□	□	□
	1	LDY	AØ	■	□	■	□	□	□	□	□
SCAN "1"	2	"	AØ	■	□	■	□	□	□	□	□
	3	"	AØ	■	□	■	□	□	□	□	□
	4	"	AØ	■	□	■	□	□	□	□	□
	5	"	AØ	■	□	■	□	□	□	□	□
	6	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "2"	7	LDY	AØ	■	□	■	□	□	□	□	□
	8	"	AØ	■	□	■	□	□	□	□	□
	9	"	AØ	■	□	■	□	□	□	□	□
	10	"	AØ	■	□	■	□	□	□	□	□
	11	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "3"	12	LDY	AØ	■	□	■	□	□	□	□	□
	13	"	AØ	■	□	■	□	□	□	□	□
	14	"	AØ	■	□	■	□	□	□	□	□
	15	"	AØ	■	□	■	□	□	□	□	□
	16	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "4"	17	LDY	AØ	■	□	■	□	□	□	□	□
	18	"	AØ	■	□	■	□	□	□	□	□
	19	"	AØ	■	□	■	□	□	□	□	□
	20	"	AØ	■	□	■	□	□	□	□	□
	21	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "5"	22	LDY	AØ	■	□	■	□	□	□	□	□
	23	"	AØ	■	□	■	□	□	□	□	□
	24	"	AØ	■	□	■	□	□	□	□	□
	25	"	AØ	■	□	■	□	□	□	□	□
	26	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "6"	27	LDY	AØ	■	□	■	□	□	□	□	□
	28	"	AØ	■	□	■	□	□	□	□	□
	29	"	AØ	■	□	■	□	□	□	□	□
	30	"	AØ	■	□	■	□	□	□	□	□
	31	RTS	6Ø	□	■	■	□	□	□	□	□

6L-S40
PROM NUMBER
□ = "0"
■ = "1"
(POSITIVE LOGIC)

6502 CODING

USE ONLY FOR 40 CHARACTER LINE REPACKED ALPHANUMERIC SCANS.

Fig. 9. Truth table for Scan PROM 6L-S40.

Fancier and more specialized PROM coding is needed if we are going to densely repack 40- or 80-character lines. Fig. 9 is the 6502 coding for a 40-character scan, while Fig. 10 is the coding for an 80-character scan. Both PROMs provide for repacking so that each page of 256 words has three 80-character lines or six 40-character lines.

Connections for either repacked PROM are shown in Fig. 11. An external three-input AND gate is used that lets us get the needed 128 equivalent words out of a 32-word PROM.

Your turn: Show how three switches or jumpers may be added to Fig. 11 to allow the same alphanumeric circuit board to work with any of the three scan truth tables shown.

Be sure to notice the difference in how the enable input is treated between the instruction decoder PROM and the Scan microprogram PROM. In the instruction decoder, the outputs must always be active, so we permanently enable this PROM. In the Scan microprogram PROM, we have to be able to Tri-state-float the outputs for all non-TVT times, and we drive the PROM's chip enable from an

	WORD #	WHAT DOES THIS WORD DO ?	HEX OP-CODE	Q8 DB7	Q7 DB6	Q6 DB5	Q5 DB4	Q4 DB3	Q3 DB2	Q2 DB1	Q1 DBØ
	0	LDY	AØ	■	□	■	□	□	□	□	□
	1	"	AØ	■	□	■	□	□	□	□	□
SCAN "1"	2	"	AØ	■	□	■	□	□	□	□	□
	3	"	AØ	■	□	■	□	□	□	□	□
	4	"	AØ	■	□	■	□	□	□	□	□
	5	"	AØ	■	□	■	□	□	□	□	□
	6	"	AØ	■	□	■	□	□	□	□	□
	7	"	AØ	■	□	■	□	□	□	□	□
	8	"	AØ	■	□	■	□	□	□	□	□
	9	"	AØ	■	□	■	□	□	□	□	□
	10	"	AØ	■	□	■	□	□	□	□	□
	11	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "2"	12	LDY	AØ	■	□	■	□	□	□	□	□
	13	"	AØ	■	□	■	□	□	□	□	□
	14	"	AØ	■	□	■	□	□	□	□	□
	15	"	AØ	■	□	■	□	□	□	□	□
	16	"	AØ	■	□	■	□	□	□	□	□
	17	"	AØ	■	□	■	□	□	□	□	□
	18	"	AØ	■	□	■	□	□	□	□	□
	19	"	AØ	■	□	■	□	□	□	□	□
	20	"	AØ	■	□	■	□	□	□	□	□
	21	RTS	6Ø	□	■	■	□	□	□	□	□
SCAN "3"	22	LDY	AØ	■	□	■	□	□	□	□	□
	23	"	AØ	■	□	■	□	□	□	□	□
	24	"	AØ	■	□	■	□	□	□	□	□
	25	"	AØ	■	□	■	□	□	□	□	□
	26	"	AØ	■	□	■	□	□	□	□	□
	27	"	AØ	■	□	■	□	□	□	□	□
	28	"	AØ	■	□	■	□	□	□	□	□
	29	"	AØ	■	□	■	□	□	□	□	□
	30	"	AØ	■	□	■	□	□	□	□	□
	31	RTS	6Ø	□	■	■	□	□	□	□	□

6L-S80
PROM NUMBER
□ = "0"
■ = "1"
(POSITIVE LOGIC)

6502 CODING

USE ONLY FOR 80 CHARACTER LINE REPACKED ALPHANUMERIC SCANS.

Fig. 10. Truth table for Scan PROM 6L-S80.

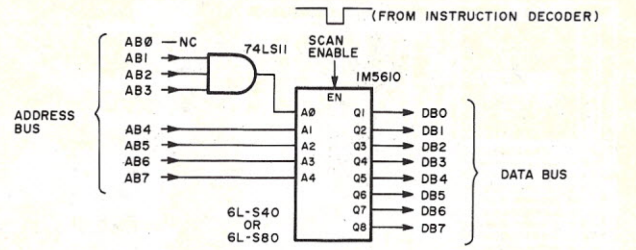


Fig. 11. Connections for 6L-S40 and 6L-S80 Scan PROMs that give densely repacked 40- or 80-character lines.

instruction decoder output, going low only when a scan is wanted. The instruction decoder PROM could be Tri-state, open collector or even permanently internally enabled, but the scan microprogram PROM *must* be Tri-state.

The instruction decoder PROM, the scan microprogram PROMs and possibly an AND gate or two are usually all we need to get a microprocessor outputting character or chunk words in a sequence and form that eventually will give us good video. The only signals fed back from the interface hardware to the microcomputer originate in these two PROMs. These signals are:

DEN: Decode Enable that goes high whenever a scan is to be produced and stops anything else from grabbing the data bus during scan times.

CSO: Chip Select Output that enables the display memory, either when the computer wants it for normal use or when the TVT wants to get characters out the upstream tap.

DB0-DB7: Data Bus outputs from the scan microprogram generator that are active whenever a scan is wanted, but Tri-state-floated otherwise.

The important thing to note is that these two PROMs plus any supporting gating always should be designed, tested and debugged first in any microprocessor-based video display. If they can't make the computer behave the way you want it to, nothing else you add in the way of interface hardware is going to work, either. ■

John Blankenship
DeVry Institute of Technology
828 W. Peachtree N.W.
Atlanta GA 30308

Expand Your KIM!

. . . Part 2: getting to the nuts and bolts

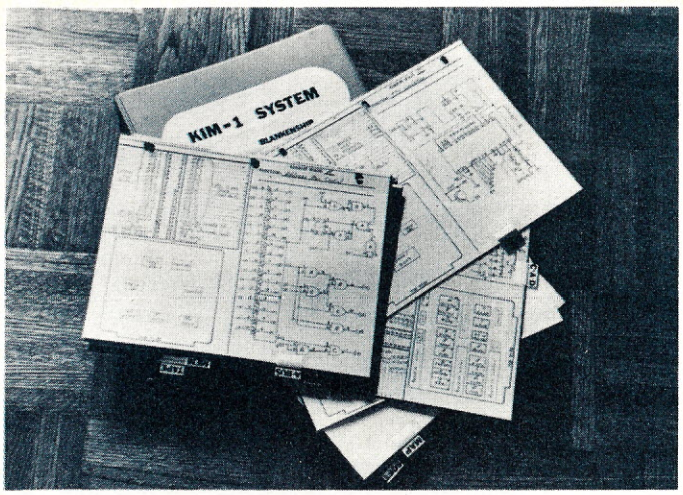


Photo 1. Complete documentation — very helpful.

Last month, I described my KIM-1 System. This article is dedicated to the laborious task of constructing the mainframe, cabinet and power supply. I say laborious because this part of the construction will use up the majority of the total time required by the project.

For the most part, I shall refrain from philosophical discussions at this point, as they will be more applicable if included with the discussions of the boards themselves.

Photo 1 shows the notebook I'm keeping of all finalized material on my system. Documentation cannot be emphasized too much, and I encourage you to keep file folders and/or a notebook on all aspects of your system. As you begin to program, or if you should need to make repairs at a later date, you'll find complete documentation invaluable.

The mainframe (Photo 2) is made from light-gauge aluminum U-shaped tubing. Notice that some of the tubing is small enough to slide inside the others, and

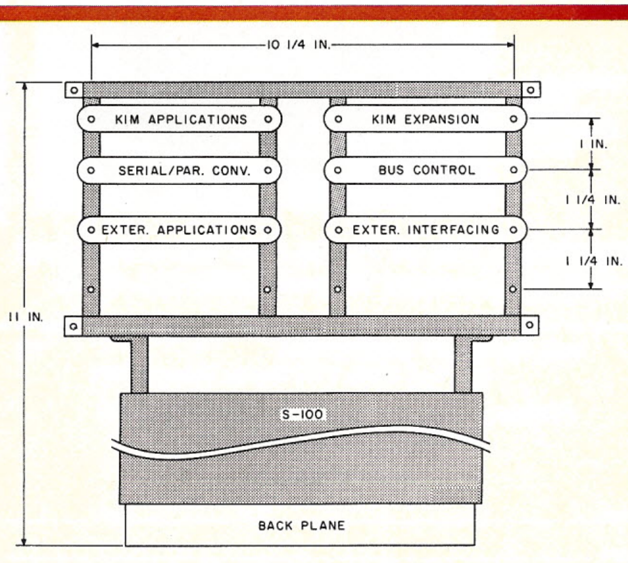


Fig. 1. Layout of mainframe connectors.

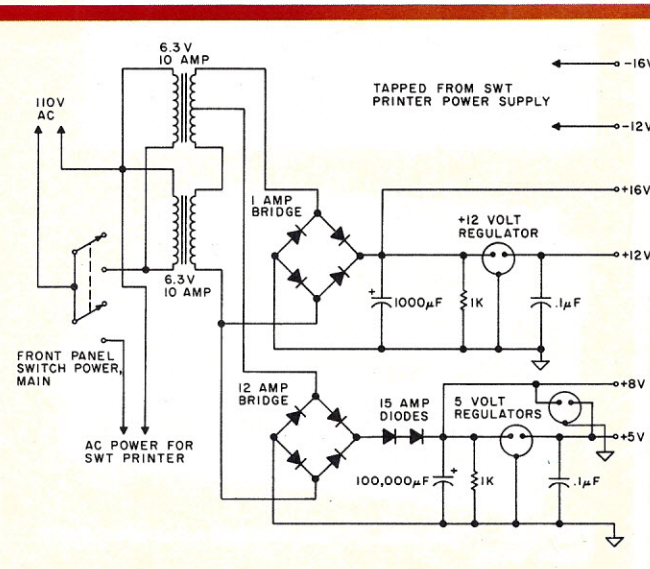


Fig. 2. Mainframe wiring information.

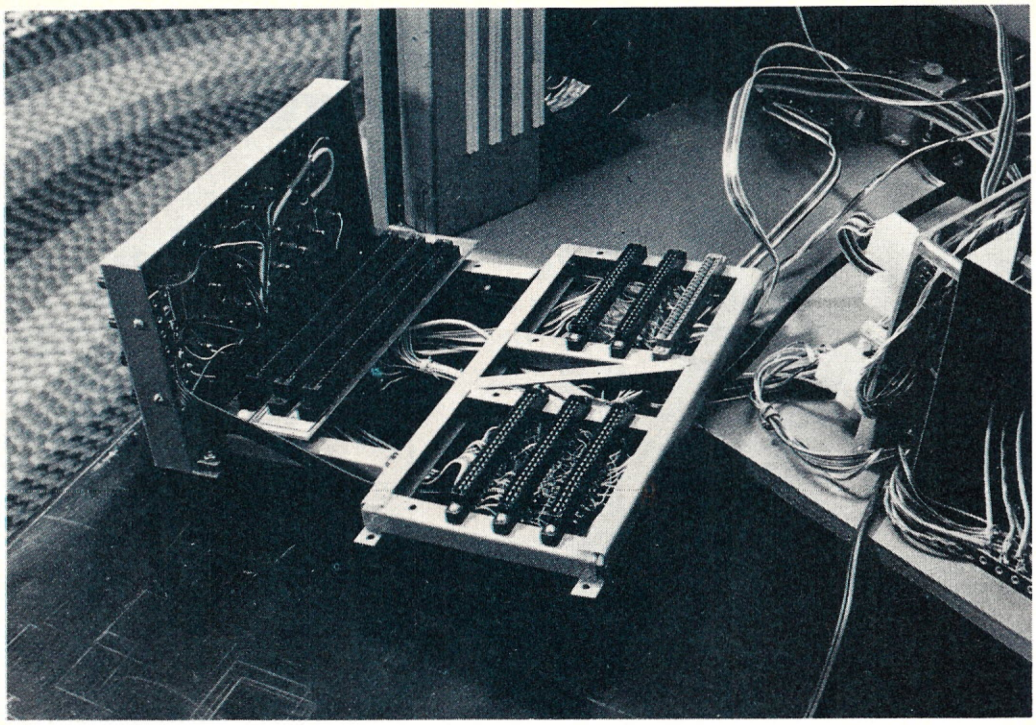


Photo 2. The mainframe is made from aluminum, epoxy and sheet metal screws. *Photos by Thomas Snider*

may be fastened together with epoxy and sheet metal screws.

My 44-pin connectors are spaced 1¼ inches apart to allow room for wire-wrap sockets. The linear spacing of the 44-pin connectors matches that of the KIM board. Space has been left for two more sockets, in case my requirements alter in the future.

The Imsai motherboard mounts on an extension of the tubular frame and leaves enough space for piggy-backing the Dazzler in the front slot. The backplane bolts to the mainframe, thus eliminating many wiring problems. Since the wires run under the frame, spacers are required when mounting to the cabinet base. Note the spacers on the bolts where the backplane is attached. This allows the backplane to mount flush, providing more stability. The front-to-back measurements should not exceed 11 inches if you use my cabinet dimensions.

The wiring of the frame is tedious and complex. Keep all the wires as short and as neat as possible. With the number of connections necessary, don't expect it to be a work of art (see Photo 3).

Fig. 1 shows the layout of the 44-pin connectors. Fig. 2 provides all the information necessary to complete the wiring. I chose it as the most efficient means of supplying the large amount of information required.

The power supply transformers will mount under the steel bracket that holds the printer (see Photo 3). The heat sinks for the 5 V regulators and rectifiers mount on the left side of the bracket (see Photo 5 in last month's article), while the printer electronics mount on the right side. The would-be wasted space under the keyboards holds the filter capacitors and 12 V regulator. A complete schematic of the power supply is shown in Fig. 3.

The cabinet is made up of a plywood base 19 x 28 3/4 inches and two sides of 1 x 12 inch shelving. The sheet aluminum front panel was bent to shape first, and then the sides cut to match. That might be less than scientific, but much easier than the other way around. The sides are grooved 1/4 inch deep on all edges except the bottom to allow the metal panels to slide in place. For ease in cutting, the grooves extended to each edge of the board, and the undesired gaps were later filled in with plastic wood. Fig. 4 shows an expanded view of the cabinet. The dimensions are only included as general guidelines, and can be changed to fit your personal tastes.

A 1 x 2 inch wood strip across the top front edge holds the sides together firmly, and also provides a good looking termination point for the sheet metal.

I chose to paint all the wood parts dark blue and all the metal parts light blue. The combination is attractive, and I recommend it.

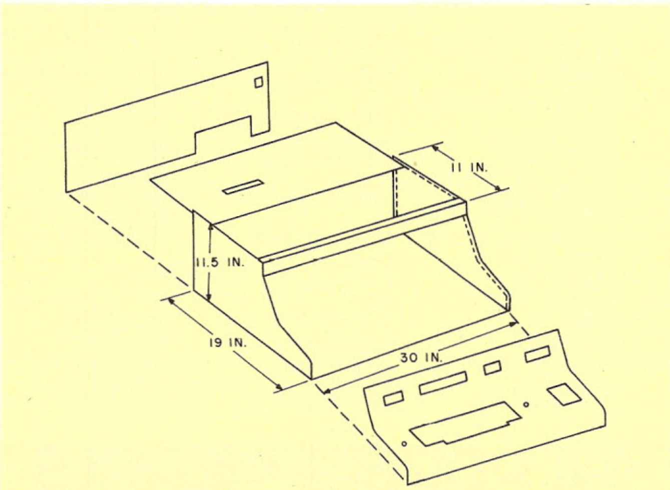


Fig. 4. Expanded view of cabinet.

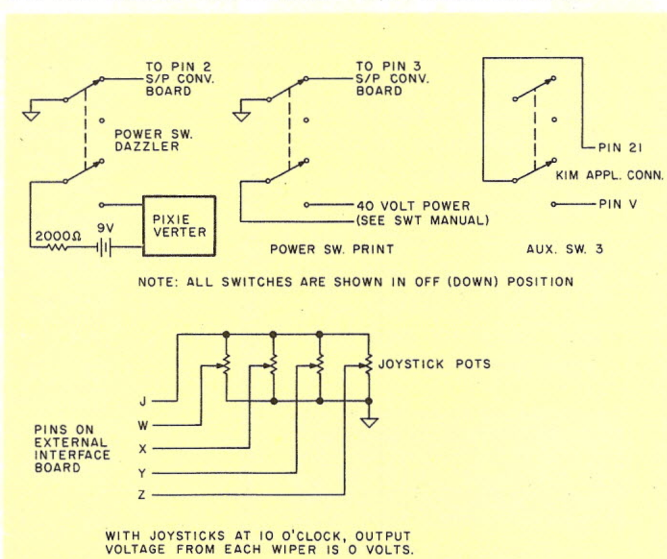


Fig. 5. Miscellaneous circuits.

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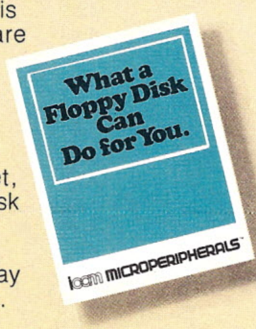

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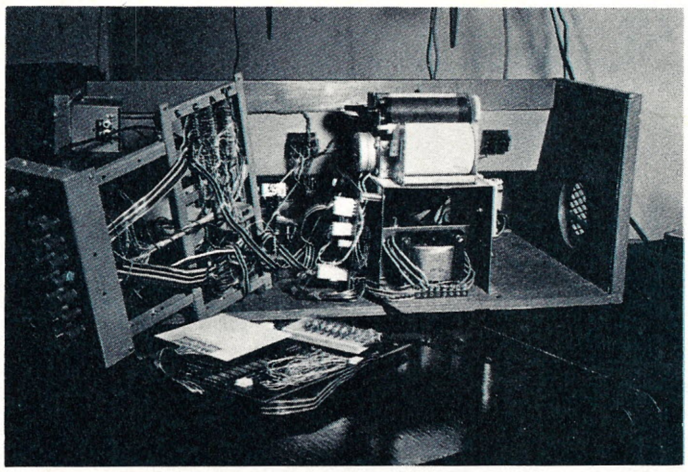

Photo 3. All wires on the mainframe should be as short and neat as possible.

One suggestion: If you mount the power supply components on the base before the sides and front panel are assembled, you can avoid a lot of frustration due to cramped working conditions under the keyboard.

There are several other items that are worthy of comment. A section of 2 x 4 inch wood block provides a mounting surface for edge guides to insure separation of the S-100 boards (see Photo 2 top center).

A metal box for holding the Pixie-Verter is mounted above this block. Two phono jacks on the rear provide the video and rf outputs. Two more jacks on the front provide the video inputs and connections to a power switch on the front panel.

The construction described in this article should keep you busy till later, when I'll cover the bus control board and modifications to the SD Sales 4K memory board. A word to those who like to get a step ahead: Don't expect the KIM to operate until the bus control board is in place. ■

Fig. 2. Mainframe wiring information (continued on following pages).

BUS CONTROL BOARD

Pin	Name		Connects	Comments
1	AB0	IN	From KIM E-A (Expansion Connector, Pin A)	
2	AB1	IN	From KIM E-B	
3	AB2	IN	From KIM E-C	
4	AB3	IN	From KIM E-D	
5	AB4	IN	From KIM E-E	
6	AB5	IN	From KIM E-F	
7	AB6	IN	From KIM E-H	These signals are inputs
8	AB7	IN	From KIM E-J	to the Tri-state bus drivers.
9	AB8	IN	From KIM E-K	
10	AB9	IN	From KIM E-L	
11	AB10	IN	From KIM E-M	
12	AB11	IN	From KIM E-N	
13	AB12	IN	From KIM E-P	
14	AB13	IN	From KIM E-R	
15	AB14	IN	From KIM E-S	
16	AB15	IN	From KIM E-T	
17	Lower 8K enable		To KIM A-K	Enables KIM on-board Memory when addressed.
18	RAM R/W		To S-100 68	Simulates MWRITE.
19	Ready		To KIM E-2	Low level puts processor in Hold.
20	Ø2 clock		From KIM E-4	The KIM clock is used
			To S-100 24	for all external timing.
			To S/P converter board 22	
			To External Interfacing Board K	
21	+5 volts (Req)		From S/P converter board A	
22	Ground		From S/P converter board E	
A	AB0	OUT	To S-100 79, Ext. Int. 1	
B	AB1	OUT	To S-100 80, Ext. Int. 2	
C	AB2		To S-100 81, Ext. Int. 3	
D	AB3		To S-100 31, Ext. Int. 4	
E	AB4		To S-100 30, Ext. Int. 5	
F	AB5		To S-100 29, Ext. Int. 6	
H	AB6		To S-100 82, Ext. Int. 7	Outputs of address bus buffers.
J	AB7		To S-100 83, Ext. Int. 8	
K	AB8		To S-100 84	
L	AB9		To S-100 34	
M	AB10		To S-100 37	
N	AB11		To S-100 87	
P	AB12		To S-100 33	
R	AB13		To S-100 85	
S	AB14		To S-100 86	
T	AB15		To S-100 32	
U	I/O enable		To S-100 45, 46	High level indications I/O operation.
			To Ext. Int. 13	
V	Interrupt enable		To KIM A-J	Low level indicates page FF accessed.
W	W/R		From KIM E-V	
			To S-100 78	Simulates PDBIN.
			To Ext. Int. 14	

X	Sync	From KIM E-1	
Y	Hold Request	From S/P converter board 20 From S-100 74	Puts processor in Hold during carriage return. Hold request from Dazzler.
Z	Hold Acknowledge	To S-100 26	High level indicates Dazzler may proceed.

SERIAL/PARALLEL CONVERTER BOARD

Pin	Name	Connects	Comments
A	+5 Regulated	To KIM A-A To Ext. Int. 12 To S/P converter board M To PIA Applications F	Pins A through H connect also to power supply by ribbon cable. Allow two wires each for +5, +8 and ground due to high current levels.
B	+8	To S-100 1, 51	
C	-15	To S-100 52	
D	-12	To PIA Applications D To S/P converter board Z To Ext. Int. H	
E	Ground	To PIA applications Z To KIM A-1 To Ext. Int. L To S/P interface board Y and 21 To S-100 50, 70	
F	+12	To Ext. Int. 10	
H	+15	To PIA Applications E To S-100 2	
J	Echo		
K	Xmit		
L	RCVE		
M	+5		
N	Parity		
P	B7 (MSB)	To SWTP keyboard pins of same name by way of ribbon cable	
R	B6		
S	B5		
T	B4		
U	B3	To SWTP keyboard pins of same name by way of ribbon cable.	
V	B2		
W	B1 (LSB)		
X	KP		
Y	Ground		
Z	-12		
1	RST	From KIM E-7	Used to reset UART.
2	Dazzler OFF	To S-100 99	Turns Dazzler off whenever an ASCII key is depressed to prevent possible noise generation from interfering with ASCII transfer. (Full discussion in later articles.)
		To front panel switch POWER, DAZ	When switch is in off position, this point is shorted to ground. This switch (DPDT) also connects a 9 V battery through a 2000 Ohm resistor to the Pixie-Verter when on (see Fig. 5).
3	Print OFF	To front panel switch POWER, Print	When switch is off, this point is shorted to ground, thus disabling transfers to printer. This switch (DPDT) also disables the 40 V solenoid power when off as indicated in the SWTP Printer manual (see Fig. 5).
6	TTY PRNT	From KIM A-U To Backplane	If S/P board is removed, a standard TTY may be connected to KIM by way of backplane.
7	TTY KYBD	From KIM A-T To Backplane	
8	PRNT RTRN	From KIM A-S To Backplane	
9	KYBD RTRN	From KIM A-R To Backplane	
12	B2		
13	B1		
14	BO (LSB)		
15	B4	These pins connect SWTP Printer connector J-4 to pins of same name by way of ribbon cable.	Male connector for end of this cable is included in SWTP Printer Kit.
16	B3		

17	B6 (MSB)
18	B5
19	Data Ready
20	Data Accept
21	ground

EXTERNAL INTERFACING BOARD

Pin	Name	Connects	Comments
9	RAM R/W	From KIM E-Z	Used to control write to output ports for D/A conversion.
15	DB7	From KIM E-8 To S-100 90, 43	
16	DB6	From KIM E-9 To S-100 40, 93	
17	DB5	From KIM E-10 To S-100 39, 92	
18	DB4	From KIM E-11 To S-100 38, 91	Because of Tri-state buffering the KIM bidirectional bus may be connected to both S-100 data buses.
19	DB3	From KIM E-12 To S-100 89, 42	
20	DB2	From KIM E-13 To S-100 88, 41	
21	DB1	From KIM E-14 To S-100 35, 94	
22	DB0	From KIM E-15 To S-100 36, 95	
A	A/D, D	From Backplane	When selected, these analog inputs are read digitally
B	A/D, C	From Backplane	as memory locations.
C	A/D, B	From Backplane	
D	A/D, A	From Backplane	
E	D/A, B	To Backplane	These outputs are analog signals
F	D/A, A	To Backplane	from processor accessible ports.
J	Ref Voltage	To Joysticks	This output is Joystick voltage reference (see Fig. 5 for connections).
M	SS7 (MSB)	From sense switch 7	The sense switches, when down, short
N	SS6	From sense switch 6	these pins to ground.
P	SS5	From sense switch 5	
R	SS4	From sense switch 4	
S	SS3	From sense switch 3	
T	SS2	From sense switch 2	
U	SS1	From sense switch 1	
V	SS0 (LSB)	From sense switch 0	
W	JSRV	From wiper, right hand, vertical joystick port.	See Fig. 5.
X	JSRH	From wiper, right hand, horizontal joystick port.	
Y	JSLV	From wiper, left hand, vertical joystick port.	
Z	JSLH	From wiper, right hand, horizontal joystick port.	

PIA APPLICATIONS BOARD

Pin	Name	Connects	Comments
A	IRQ	To KIM E-4	
H	PB5	To KIM A-16	
J	BB7	To KIM A-15	
K	PA0	To KIM A-14	
L	PB4	To KIM A-13	
M	PB3	To KIM A-12	
N	PB2	To KIM A-11	
P	PB1	To KIM A-10	Each of these pins also connects to
R	PB0	To KIM A-9	backplane jack of same name.
S	PA7	To KIM A-8	
T	PA6	To KIM A-7	
U	PA5	To KIM A-6	
V	PA4	To KIM A-5	
W	PA1	To KIM A-4	
X	PA2	To KIM A-3	
Y	PA3	To KIM A-2	

KIM APPLICATIONS CONNECTOR

Pin	Name	Connects	Comments
L	Audio IN	To Backplane	Use grounded shielded cable for
M	Audio out Lo	To Backplane	these connections.
V	KB Row 3	To Aux. switch 1	When switch is in the up position these two pins are
21	KB col A	To Aux. switch 1	shorted together, putting KIM into TTY mode (see Fig. 5).

UP AND RUNNING

TDL EQUIPMENT USED BY NEW JERSEY PUBLIC TELEVISION TO PROCESS NEW JERSEY GUBERNATORIAL PRIMARY ELECTION RETURNS

John Montagna, computer engineer (above left), lead this successful network team in generating election results speedily, efficiently and reliably using predominantly TDL hardware and software. Montagna created three programs to get the job done. The text for a SWAPPER program was written and assembled using the TDL TEXT EDITOR and Z80 RELOCATING MACRO ASSEMBLER. The SWAPPER text and all debugging was run through TDL's ZAPPLE MONITOR. The relocatable object code was punched onto paper tape. A MAIN USERS program updated votes and controlled air display. An ALTERNATE USERS program got hard copy out and votes in. The latter two programs were written in BASIC. Montagna modified the ZAPPLE BASIC to permit time-sharing between the two USERS programs.

Four screens were incorporated, two terminals entered votes as they came in and were used to call back votes to check accuracy. Montagna called on the power and flexibility offered by TDL's ZPU board and three Z-16 Memory boards.

Montagna's setup worked constantly for over four hours updating and displaying state-wide and county-wide results without flaw.

"I chose TDL because they have all the software to support their hardware, and it's good; it has the flexibility to do the job."
John Montagna

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Payroll Program (Continued)

. . . cassette techniques

Ron Harvey
Computer Radio Workshop
120 El Dorado Ct.
Cheyenne WY 82001

This is the third in a series of articles on microcomputer business applications and BASIC language programming. In the first article describing a program to tally sales receipts and prepare a sales tax return ("Learn and Earn," *Kilobaud*, Oct. 1977), we discussed a limitation of BASIC that does not provide a method to prepare a data file for later use. This was not a serious problem in the program because daily totals could be reentered to keep the figures updated. However, in the payroll program the necessity for the businessman to keep year-to-date figures for his payroll and deductions became apparent. In order to prepare year-end tax forms and know when to stop social-security deductions, as well as keep track of several sets of figures for a number of employees, a separate set of books with manual entries and periodic review would be required.

By being able to accumulate totals on a week-to-week basis, several timesaving benefits are realized:

1. Separate written bookkeeping is eliminated.
2. Social-security deductions are stopped automatically by the program at the proper time.
3. Federal W-2 forms may be prepared without analyzing or figuring each employee's data.
4. The employee can be given a year-to-date status of his/her pay plus deductions each week.

The requirement to accumulate totals and retain a file becomes even more apparent when you develop other business programs, such as a general ledger, accounts receivable, inventory and tax programs.

To accomplish this goal with a small computer lacking a disk system, and with a limited or small version of BASIC, requires some software manipulations, but it can be done. As in my previous articles, an SWTP 6800 computer with CT1024 terminal and audio cassette interface provided the hardware; SWTP 4K BASIC was used to write the program.

Create a File

The only device available for keeping a permanent data record in our small system is the audio cassette recorder. Therefore, the data generated by a program run must be put on an audio cassette in a form that later can be retrieved within the next program run. With the SWTP computer, as well as many other systems on the market, the audio cassette interface is in series with the terminal and the data is in a serial ASCII format. This greatly simplifies programming as no format conversion or port changing is required. As a side note, this method will also work with a Teletype as the terminal device.

With this series arrangement the data may be transferred to tape simply by turning on the recorder at the appropriate time during the program run. Once recorded, it is simply reentered in the program on a subsequent run

Computer Radio Workshop's 6800 system and author Ron Harvey.

at the appropriate time. The RUN statement will initialize all variables to zero, so the reentry must occur after the program has started. Since we will be working within the BASIC program structure, several factors must be taken into consideration. These are: 1. method of entry; 2. input format; and 3. time for BASIC to execute entry. One variable could be assigned and entered for each INPUT command: 100 INPUT X, 200 INPUT Y, etc.

Input File to BASIC

An examination of 4K BASIC indicates that the INPUT statement is the only method to enter data to a running program. Several variables may be entered at a time by the use of commas, according to the BASIC manual. With the number of variables that would normally be entered in a business program, the simplest method would be to put the INPUT statement in a FOR-NEXT loop. This requires that the execution time be taken into consideration in the data coming from the tape. Since the tape transport will be running at a constant speed, the data must be separated on the tape by a sufficient interval to allow the INPUT loop to accept it. This timing must be incorporated in the output routine to record the data.

Output From BASIC

The PRINT statement is the only method to output the data from an array to tape, and it will output it just as fast as BASIC and the terminal speed permit. Again, the FOR-NEXT loop is the most efficient way to output the large arrays produced by the program. Several variables may be output at one time in a PRINT statement with corresponding INPUT statements. Between successive PRINT statements, time must be provided for the future input loop to respond.

This is the theory used to create a data file in BASIC with a small computer system. Now, let's take a look at the software required and a practical application in the payroll program.

Program Description

The payroll program previously published in *Kilobaud* (Nov. 1977) is listed again in its entirety with the additions required to create a data file plus an update on the tax tables. The update results from a change in withholdings by Uncle Sam since the first article was submitted for publication. Unfortunately, these changes will occur from time to time, and you must keep up to date on them. A sample tax table, available from the IRS, is shown in Fig. 1.

The input routine is simple and appears at lines 190 through 220, a FOR-NEXT loop to enter data for one employee at a time. The variables in the INPUT at line 210 are the employees' year-to-date figures from the previous program run. These include gross pay E(N,10), social security E(N,11), federal income tax E(N,12) and miscellaneous deductions E(N,13). The N variable of the FOR-NEXT loop corresponds to the employee number. This input routine is followed by an undefined INPUT statement at line 230, which halts the program until the user turns off the recorder and types a RETURN. The program then continues with a home-up-and-erase, and starts processing the new

Program listing. Modified payroll program (will now create data files and update tax tables).

```
0100  PRINT CHR(16); CHR(22)
0110  READ Z
0120  DIM E(Z,14)
0130  PRINT "PAYROLL PROGRAM FOR 6800"
0140  PRINT
0150  PRINT "BY RON S. HARVEY, SR. PARTNER"
0160  PRINT "COMPUTER RADIO WORKSHOP"
0170  PRINT"CHEYENNE, WYOMING"
0180  PRINT
0190  PRINT "INPUT LAST PERIOD DATA FILE"
0200  FOR N = 1 TO Z
0210  INPUT E(N,10), E(N,11), E(N,12), E(N,13)
0220  NEXT N
0230  INPUT
0240  PRINT CHR(16), CHR(22)
0250  PRINT "PAY PERIOD ENDING (M D Y) ";
0260  INPUT M, D, Y
0270  FOR N = 1 TO Z
0280  READ E(N,1), E(N,2), E(N,3), E(N,4)
0290  IF E(N,4) = Ø THEN 330
0300  PRINT CHR(22)
0310  PRINT "EMP.NO. "; (N + 1000), "HRS PAID ";
0320  INPUT E(N,5)
0330  NEXT N
0340  PRINT "CORRECTIONS ";
0350  INPUT A
0360  IF A = Ø THEN 430
0370  PRINT "EMP.NO. ";
0380  INPUT A
0390  LET N = A-1000
0400  PRINT "EMP.NO. "; (N + 1000), "HRS PAID ";
0410  INPUT E(N,5)
0420  GOTO 340
0430  FOR N = 1 to Z
```

```
0440  IF E(N,5) > 40 THEN 470
0450  LET E(N,6) = E(N,4) * E(N,5)
0460  GOTO 480
0470  LET E(N,6) = E(N,4) * E(N,5) + E(N,4)/2*(E(N,5)-40)
0480  LET E(N,6) = INT (E(N,6) * 100 + .5)/100
0490  LET E(N,7) = INT ((E(N,6) * .0585)*100+.5)/100
0500  IF E(N,10) > 16500 THEN E(N,7) = Ø
0510  IF E(N,11) + E(N,7) = > 965.25 THEN E(N,7) = 965.25-E(N,11)
0520  IF E(N,2) = Ø GOSUB 1100
0530  IF E(N,2) = 1 GOSUB 1200
0540  LET E(N,8) = INT (E(N,8) * 100 + .5)/100
0550  LET E(N,9) = Ø
0560  LET E(N,14) = E(N,6) - E(N,7) - E(N,8) - E(N,9)
0570  LET E(N,10) = E(N,10)+ E(N,6)
0580  LET E(N,11) = E(N,11) + E(N,7)
0590  LET E(N,12) = E(N,12) + E(N,8)
0600  LET E(N,13) = E(N,13) + E(N,9)
0610  LET F = F + E(N,7)
0620  LET I = I + E(N,8)
0630  LET L = L + E(N,9)
0640  LET P = P + E(N,14)
0650  IF E(N,4) = Ø THEN 700
0660  IF E(N,5) = Ø THEN 700
0670  GOSUB 720
0680  PRINT "CONTINUE ";
0690  INPUT
0700  NEXT N
0710  GOTO 920
0720  PRINT "CHR(16); CHR(22)
0730  PRINT "EMP.NO. "; (N + 1000), "DATE "; M; D; Y
0740  PRINT "SS "; E(N,1), "RATE "; E(N,4)
0750  IF E(N,2) = Ø GOSUB 880
0760  IF E(N,2) = 1 GOSUB 900
0770  PRINT
0780  PRINT TAB (10);   "PAY", "Y-T-D"
0790  PRINT "GROSS        "; E(N,6), E(N,10)
0800  PRINT "F.I.C.A.     "; E(N,7), E(N,11)
0810  PRINT "F.I.T.       "; E(N,8), E(N,12)
0820  PRINT "MISC         "; E(N,9), E(N,13)
0830  PRINT "                 - - - - - -"
0840  PRINT "NET PAY "; E(N,14)
0850  PRINT
0860  PRINT
0870  RETURN
0880  PRINT "SINGLE "; E(N,3), "HRS "; E(N,5)
0890  RETURN
0900  PRINT "MARRIED "; E(N,3), "HRS "; E(N,5)
0910  RETURN
0920  PRINT "RECORD FILE COPY ";
0930  INPUT A
0940  IF A = Ø THEN 1300
0950  IF A   1 THEN 930
0960  FOR N = 1 TO Z
0970  GOSUB 720
0980  NEXT N
0990  GOTO 1300
1000  DATA Z
1001  DATA E(N,1), E(N,2), E(N,3), E(N,4)
1002    (SEE TEXT FOR DATA VALUES)
1099  DATA
1100  LET G = E(N,6) - (E(N,3) * 14.40)
1110  IF G>= 355 THEN E(N,8) = (G-355)* .36 + 76.76
1120  IF G <  355 THEN E(N,8) = (G-297)* .32 + 58.20
1130  IF G <  297 THEN E(N,8) = (G-220)* .28 + 36.64
1140  IF G <  220 THEN E(N,8) = (G-182)* .24 + 27.52
1150  IF G <  182 THEN E(N,8) = (G-143)* .22 + 18.94
1160  IF G <  143 THEN E(N,8) = (G- 76)* .18 +  6.88
1170  IF G <   76 THEN E(N,8) = (G- 33)* .16
1180  IF G <   33 THEN E(N,8) = Ø
1190  RETURN
1200  LET G = E(N,3)*  14.40)
1210  IF G > = 509 THEN E(N,8) = (G-500)* .36 + 105.39
1220  IF G  <  509 THEN E(N,8) = (G-433)* .32 +  80.75
1230  IF G  <  432 THEN E(N,8) = (G-346)* .28 +  59.19
1240  IF G  <  355 THEN E(N,8) = (G-264)* .25 +  39.94
```

payroll.

The manipulation of the payroll data has been discussed in detail in the first article, and only the additional lines required for the year-to-date files will be explained here.

Social-security deductions stop when a maximum of $965.25 has been paid, and social security is not paid on income after $16,500. Line 500 assures that $965.25 is the maximum paid, even if it occurs in the middle of a pay period.

In order to accumulate totals for our permanent file tape, lines 570-600 total the last period file, entered in lines 190-220, and the results of the current run. These year-to-date figures are added to the PRINT routine in lines 790-820 for display purposes.

Using the processed payroll data, all that remains is to make a permanent year-to-date tape file for the next pay period.

The output routine to create a data file is contained in lines 1420-1560. This routine formats the data in proper sequence and provides the timing sequence of data to tape for proper execution of the input routine. Line 1420 puts a title on tape that helps to find the proper data to enter in the program. Remember, the cassette interface (or punched tape) is in series with the terminal, and with the interface in a local mode, this title will appear on the screen and the starting location of the data can be located before running the program. Following the title (lines 1430, 1440) is a timing loop to allow for a leader tape and time to turn on the interface switch to enter data. Using the SWTP 4K BASIC, this timing is about three seconds. The actual value of the time constant in this "clock" and the one at lines 1530-1550 depend on the execution time of BASIC and will vary from one BASIC to another. They should be adjusted by changing the second number of the FOR state-

```
1250  IF G  <  278 THEN E(N,8) = (G-173)* .22 +  27.84
1260  IF G  <  223 THEN E(N,8) = (G- 96)* .18 +   6.60
1270  IF G  <  105 THEN E(N,8) = (G- 48)* .15
1280  IF G  <   61 THEN E(N,8) = Ø
1290  RETURN
1300  PRINT CHR(16); CHR(22)
1310  PRINT "PAYROLL SUMMARY FOR "; M; D; Y
1320  PRINT
1330  PRINT "FICA EMPLOYER", F
1340  PRINT "FICA WITHHELD", F
1350  PRINT "F.I.T. WITHHELD", I
1360  PRINT "MISC. WITHHELD", L
1370  PRINT
1380  PRINT "NET PAYROLL", P
1390  PRINT
1400  PRINT "PAYROLL COST "; P + L + I + (2*F)
1410  PRINT
1420  PRINT "DATA FILE FOR "; M; D; Y
1430  FOR C = 1 TO 180
1440  NEXT C
1450  FOR N = 1 TO Z
1460  GOSUB 1530
1470  PRINT E(N,10); E(N,11); E(N,12); E(N,13)
1480  GOSUB 1530
1490  NEXT N
1500  PRINT CHR(16); CHR(22); "EOF ";
1510  INPUT
1520  STOP
1530  FOR C = 1 TO 60
1540  NEXT C
1550  RETURN
1560  END

ALTERNATE LINE 1470:  (See Text)
1470  PRINT E(N,10); ", "; E(N,11); ", "; E(N,12); ", "; E(N,13)
```

FEDERAL WITHHOLDING TABLES

1977

WEEKLY Payroll Period

Value of each exemption – $14.40

Single Person – Including Head of Household

If the amount of wages, less the value of exemptions claimed is:	The amount of Federal tax to be withheld shall be:
Not over $33	0
Over $ 33 but not over $ 76	16% of excess over $ 33
Over $ 76 but not over $143	$ 6.88 plus 18% of excess over $ 76
Over $143 but not over $182	$18.94 plus 22% of excess over $143
Over $182 but not over $220	$27.52 plus 24% of excess over $182
Over $220 but not over $297	$36.64 plus 28% of excess over $220
Over $297 but not over $355	$58.20 plus 32% of excess over $297
Over $355	$76.76 plus 36% of excess over $355

Married Person

If the amount of wages, less the value of exemptions claimed is:	The amount of Federal tax to be withheld shall be:
Not over $61	0
Over $ 61 but not over $105	15% of excess over $ 61
Over $105 but not over $223	$ 6.60 plus 18% of excess over $105
Over $223 but not over $278	$ 27.84 plus 22% of excess over $223
Over $278 but not over $355	$ 39.94 plus 25% of excess over $278
Over $355 but not over $432	$ 59.19 plus 28% of excess over $355
Over $432 but not over $509	$ 80.75 plus 32% of excess over $432
Over $509	$105.39 plus 36% of excess over $509

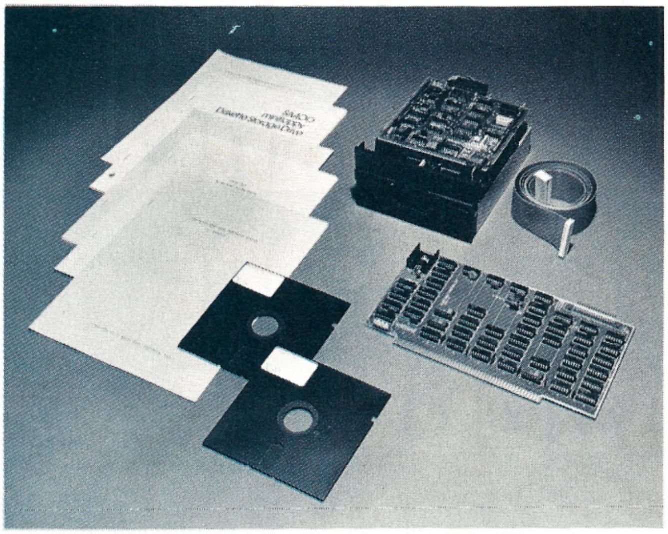
Fig. 1. IRS tax table for weekly payroll.

ment to meet a given BASIC's requirements.

The data output takes place in the FOR-NEXT loop between lines 1450 and 1490. I found that SWTP 4K BASIC INPUT would accept a space, as well as a comma, for an input delimiter. The semicolon after each variable creates a space, which makes the PRINT statement at line 1470 very simple. Other versions of BASIC may not be as loose and require a comma between variables on input. In this case the alternate line 1470 shown at the end of the listing must be used. Timing of the output to tape is provided by the "clock" at line 1530. This clock is called before and after the data output (lines 1460 and 1480) to allow the INPUT loop processing time. The time is set for reliable operation of SWTP BASIC. If this time constant is reduced, make sure that data reentry is correct. Hint – take the point at which you start getting mistakes, increase the time until there are none, then increase it some more. At the settings shown, which are approximately one second, and greater, values, you may experience some extra question marks or slashes on your screen during the interval between data entries. This is OK as long as the last character before new data is a ? (normal input prompt).

After the last byte of data is put on tape, a home-up-erase and EOF are recorded to indicate the end of file. The undefined INPUT at line 1510 stops the program execution and prevents any garbage from being put on tape while the recorder is being turned off.

The payroll program with this method of creating a file has been run through a full year (52 weeks) using five employees in the data base with perfect results for the full year. This same file routine is being used as a general ledger program to keep the books of our company. ■



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The Business Market

. . . and the business of going after it

We call ourselves computer hobbyists. We diddle with hardware and software development in a den or spare bedroom. And even though this kind of home experimentation spawned the microcomputer business, many of us wonder how we can justify the capital outlay. Buy a machine for business purposes, perhaps, or open our own retail outlet? How do people feel who already make their living in this fledgling field?

"It's fairly easy for any business to justify owning a microcomputer," says Steve Payne, one of the owners of The Computer Store in Charleston WV. "But it is only in the past year that that really has been possible."

"I'd say the hobby market is maybe a third of our retail business," says Mary Lou McJunkin, business manager for the store. "The rest has been generated by small business interests, CPAs, small computer firms and the coal industry."

Books on hardware and programming from the novice to engineering level, a wide variety of magazines, Hewlett-Packard and Texas Instruments calculators are some of the things that draw people to The Computer Store from as far away as Kentucky, Ohio, and Virginia.

Coal is big business in West Virginia, and it's destined to get even bigger under Washington's present energy policy. Growth of the small computer business here may be no less startling. Steve and Bob Payne, Jim Butch and Mary Lou started cranking on their own computer store about a year ago. The story is a classic one: Steve and Jim built an early Altair 8800, saw it was more than a toy and figured others could use the machine, too. Their Mits franchise opened in November 1976, in Charleston, the state's capital and largest city (nearly twice as large as any other town in West Virginia, but still with fewer than 75,000 people).

Yet, during its short business life, The Computer Store has moved once to larger quarters, added H-P and TI calculators to their line, built an exploding software and book library, and they're serving an area that includes Ohio, Kentucky, and Virginia. Such success in this seemingly offbeat market didn't come by accident!

Success Secrets?

It was not a casual approach that secured the West Virginia franchise and made it a going concern. None of West Virginia was on the Mits list of hopeful territories when Jim Butch and Steve Payne first approached the company, and Mits apparently was apprehensive about granting the statewide franchise. They were persistent, though, and it paid off. The folks at The Computer Store admit that theirs may be a unique situation, but the

eyes-wide-open approach they've taken is a valuable lesson for anyone.

First there's the money. As Mits and other computer companies grow, business arrangements and financial requirements will change, but you'd better figure on $50,000 to $100,000 cash in hand before you go very far. The higher amount probably is more realistic, based on the Charleston store's experience. The cost of the privilege of representing a specific company, the franchisor, will exceed $10,000. Mits, and most other companies, are pretty careful in selecting representatives, too. They make sure the proposed site is a good one; they want the store itself to be attractive and professional; they investigate the prospective dealer's service facilities and technical knowledge; and they look into his financial background. It isn't easy for someone with only a hobbyist or casual interest in microcomputers to open his own business unless he is surrounded with technical and programming expertise, has solid business experience and is well financed. The Charleston operation started with all of these qualifications, and still the road was rocky.

Consider the principals. Steve Payne is an electrical engineer with a business background. He's district manager for Allen-Bradley, suppliers of industrial controllers and other electrical products. Steve's interest in microcomputers developed because his business needed real-time sales analysis using word processing.

Bob Payne is an electrical engineer who got started with computers in 1960 working with drum-type machines at MIT. In 1963 he founded Business Computer Service in Charleston, a traditional computer service bureau doing payrolls, accounts receivable and accounts payable for over 150 West Virginia firms.

Jim Butch is an electrical engineer with a background in computer design. As chief engineer for Preiser Scientific in Charleston, Jim specialized in logic design, communications equipment design and application of computer analysis equipment.

Mary Lou McJunkin is a mathematics major and programmer with general business and bookkeeping experience.

From the beginning, their approach was business oriented. Jim and Steve got into micros first, each planning a dedicated business application. Mary Lou began by

Bob Payne is proud of this Altair-based system in his office at Business Computer Service. This machine with its telephone modem keeps BCS in touch with customers who do their own data preparation on similar systems, then telephone it to Bob for processing.

helping them with programming that first Altair 8800, and brother Bob soon saw that such a machine could greatly improve his computer services by providing customers with better methods to accumulate and assess data. This need to supply others with computer hardware led them to investigate their own dealership.

"It's not a hobby thing with any of us," Bob says. "It is very interesting, and sometimes we get carried away with it from a hobby standpoint — but the impetus for us is business or industrial applications."

Whatever the market, don't forget that a computer store is a business just like any other. It may be more fun than selling used cars and more challenging and exciting than an antique shop, but it is a business nevertheless.

"Enthusiasm may help keep your labor costs down, but keeping inventory and providing service and this sort of thing is all standard business, just like any other distributor or dealer in goods," Steve warns. "The business principles are going to win out in the end."

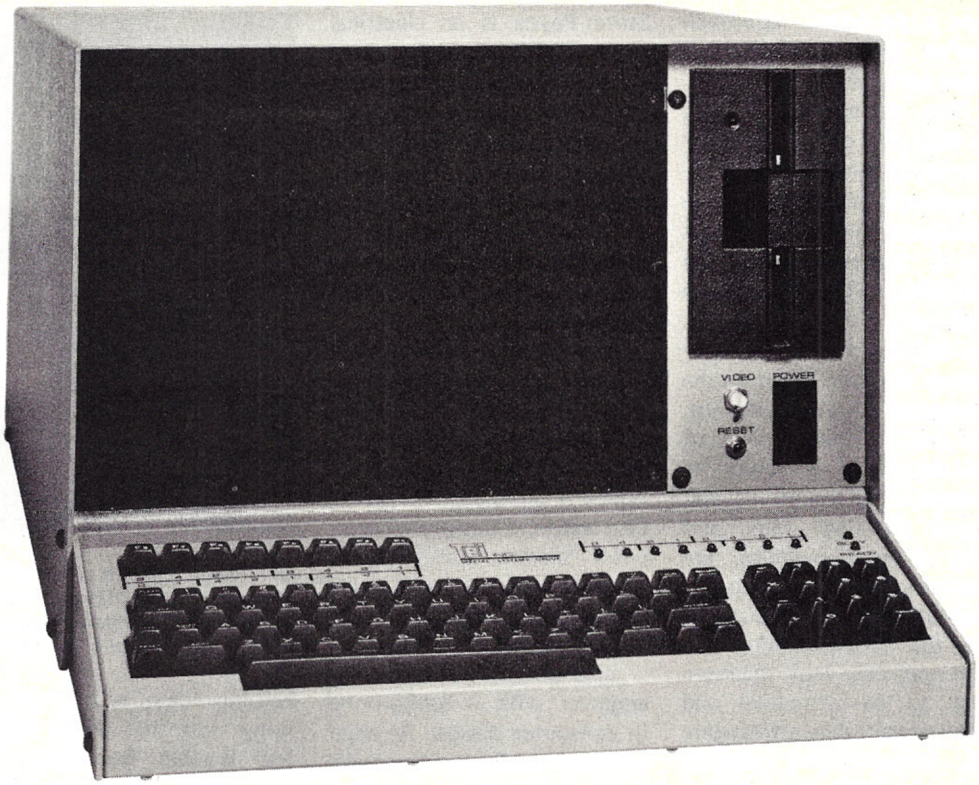
Mits helps the prospective dealer with a dealers' school in Albuquerque, where company policy and selling philosophy are explained. But in the end it is the dealer who must arrange financing, establish credit with other vendors, find a store location, purchase office furniture and supplies, secure replacement parts and handle service. "It's a long, hard process," Jim reflects.

Then there's the question of market. It was Bob's intimate knowledge of the potential market that allowed them to move rapidly. From idea to dealership was only a few months. Bob knew they wouldn't have any trouble selling business systems.

"I have 150 customers who've been dealing with me since 1963, and the principle of collecting data on the premises has been around awhile, and proved," he says. "I saw that the microcomputer could replace every one of the usual business machines and do a lot more. Besides, I felt that every small business would have its own computer in five years. *Every* small business."

Where most businesses might begin with market surveys and other data collection, The Computer Store began on gut feelings based on an intuitive belief in the small computer's potential. In fact, Bob Payne believes anyone who establishes a computer store with information solely from market surveys could be

Jim Butch, one of the owners and chief engineer for The Computer Store, had several years' experience designing and building 8080-based systems for a Charleston company before going into the retail computer business.



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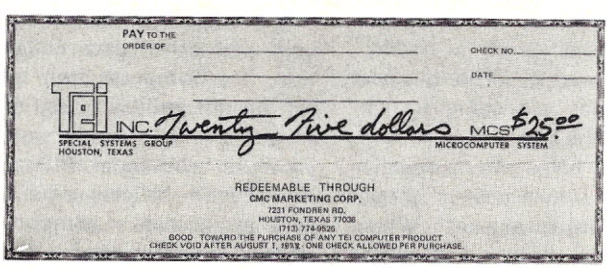

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led down a primrose path. He says surveys can be misleading. A safer bet is personal knowledge of the market you're trying to serve. Based on personal experience and national trends, none of The Computer Store founders has much confidence in the hobby market, but they see the business market as a sure thing.

"I think there will be a shift away from the hobby market toward the business market," Steve says. Bob feels the hobby market is not a viable one except in large metropolitan areas, particularly areas with a computer-oriented history like Boston, New York, Chicago, San Francisco, and Los Angeles. Nearly any community, on the other hand, could support a computer store set up to serve business and industry. In fact, Bob says, "every place you see an NCR or Burroughs office, I think there is a place big enough to support a microcomputer business.

With market information and money in hand, you're ready to approach someone about a franchise. Deciding who to represent today could be a lot more difficult in some ways than it was in 1976 when The Computer Store was organized. There are more equipment suppliers, and software support is improving. Here's where up-to-date market information will stand you in good stead. If you know exactly who you're trying to reach, and are intimately aware of their needs, then it shouldn't be difficult to pick a hardware-software package to sell.

"We picked Mits because they had business-oriented applications packages, they already had sold 7000 units and when we went out there they looked like they knew what they were doing," Bob recounts. "They had lots of momentum, they were using the concept of BASIC and they were developing an integrated programming system that would not have to be scrapped but could be carried on. They had a complete full line: disks that worked, a processor that could be expanded, and various I/O boards that could interface with a number of different terminals that were already in existence."

One of the benefits of owning a retail business is having all that hardware for your own use. Business Manager Mary Lou McJunkin (right) and programmer Cathy Willis discuss an inventory program they're rewriting for The Computer Store.

In the spring of 1976, none of the other manufacturers had all that. Jim Butch says that he and his associates also were impressed with the reliability of the Mits machine.

"We do all our own warranty work on everything we sell," he says, "and we offer service contracts (monthly payments for continued service) but usually an Altair doesn't need it. It is a pretty reliable piece of equipment."

Your marketing approach will depend on your market. An all-business, all-hobby or mixed market – each will require slightly different treatments. If The Computer Store experience is typical, however, high-priced business packages are easier to sell than hobby products in a small market. Most business people don't have to be sold on the computer; they already understand the concept of the intelligent terminal from using business machines from IBM, Univac, Burroughs, Wang and others.

"They expect it, really, as opposed to being talked into it. In fact, they wonder why I'm not more advanced," grins Bob. Business publications have so raised the expectations of potential business users that "the expectations for computers to do things are substantially greater than most manufacturers' ability to deliver."

Steve doesn't believe a supplier of microcomputer-based business systems really is in competition with IBM and the other big companies. "When IBM advertises one of its big systems on national television, that helps us more than anything because it gives added credibility to the type of product."

Bob is only half kidding when he says that their biggest competition is the pencil. "You can still do a lot of work with a pencil if you're willing to put forth the effort."

The microcomputer-based business system offers more machine for the money than most of the products from traditional sources. The tab for a micro package will run about half the cost of larger systems, and the software offered with micros usually is more versatile. This versatility aids business system marketing, too. Suppose a business has been using an accounting machine and has personnel trained to operate that equipment. The microcomputer can be programmed to act like an accounting machine and even generate the same forms familiar to accounting-machine users, and the computer system can take on other jobs as well without forcing the company to hire new personnel.

"Because of our interactive business packages, we can have the owner of a business doing his own work on his computer in a week or two," Jim says. Bob Payne's Business Computer Service presently is collecting data from perhaps 30 microprocessor-based systems, including electronic cash registers and microcomputers programmed to look like a keypunch.

The advertising of computer systems is a relatively new field. The big companies are dabbling in national television and business publications. The microcomputers are getting coverage in hobby magazines such as *Kilobaud* and a few scientific or engineering-oriented publications. The Computer Store is trying radio advertising (one spot a day) and runs an occasional newspaper ad, however, they still classify their advertising approach as experimental.

"Word of mouth probably is our strongest advertising method," states Steve. "If we put something in for somebody and do a good job, they'll recommend it to somebody else; that certainly is one of the most effective ways to do business."

"We get an amazing number of referrals from our users," Jim adds. "We're getting a good reputation because of the systems we have in the field now."

The Business System

Selling business purchasers on microcomputers may be easy, but coming through

consistently with reliable hardware and software packages to fill their needs is considerably more exacting. Only recently has microcomputer hardware approached the stringent standards of commercial users.

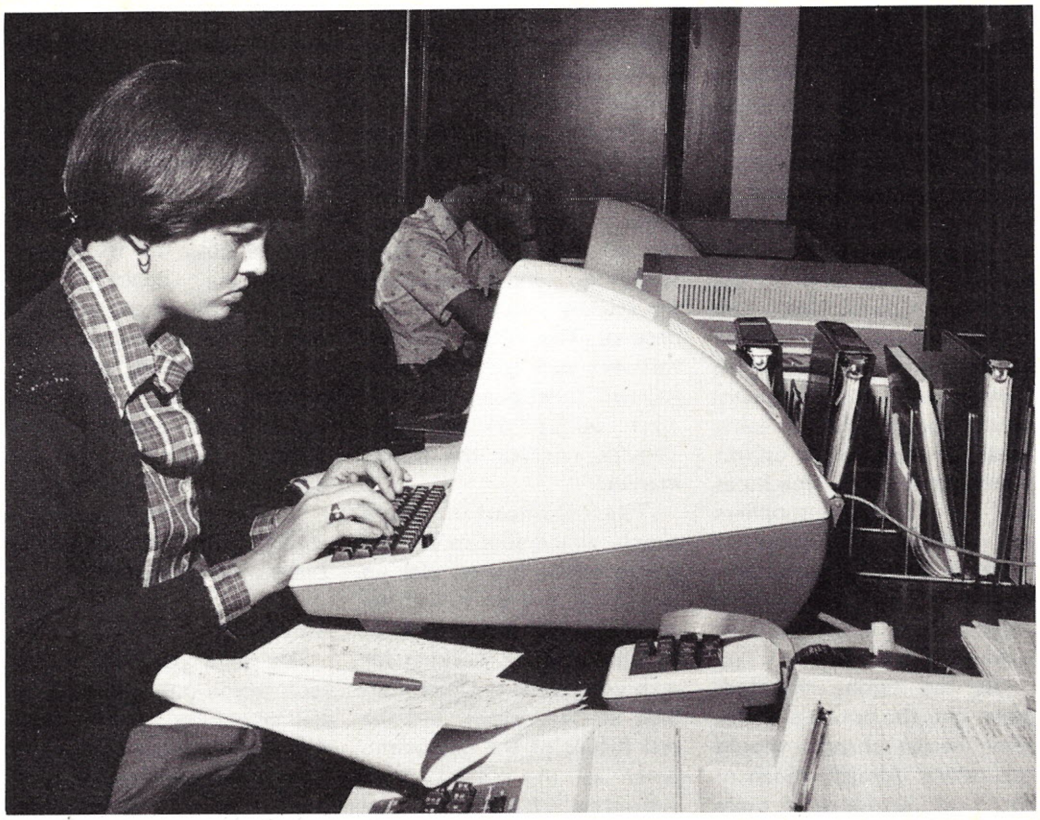
"The hobbyist is tolerant of equipment failure or mismanagement," Bob continues, "but business is absolutely intolerant. Business must have equipment that just doesn't break, period."

Many of the microcomputers that started as hobby machines have reached high enough technical standards to be considered for business service. The biggest deficiency is still software – a shortcoming that Steve Payne believes will always be a problem.

Bob is more philosophical: "A program is like a building – you can paint it, you can add to it, but if you go in there and try to change the walls, forget it. The manufacturers have not been able to build programs that can be changed without moving walls."

One way The Computer Store circumvents this problem is to custom design business software to fit their customers' needs. Two full-time programmers work on program development alongside Jim Butch and Mary Lou McJunkin, who still produce a lot of the store's software. The basic application packages come from the Altair Software Distribution Company in Atlanta and from The Software Store in Marquette MI.

There's another consideration when selling to a business market. Most business transactions are net 30 days, which means you won't get your money for up to a month after the equipment is delivered. Most hobby sales probably are cash and carry, but with a business market you have to plan your cash flow to take care of the lag in payment. The plus side is that delivery delays of 60 to 120 days aren't unusual with many businesses. When a hobbyist pays in advance or puts down a deposit, two to three weeks is about all he'll wait patiently, and deliveries sometimes take longer than that. The business purchaser doesn't have his money tied up while he's waiting, and because he's buying a fully functioning and tested system, he's content to wait.



All in a day's work. Cathy Willis is one of The Computer Store's full-time programmers. Custom program development is a growing part of their business.

Trends?

Business-minded people have definite ideas about the computer market. For one thing, it's time to take the microcomputer seriously. The new technology already is changing the way many businesses operate, and that influence will increase rapidly. The micro is changing marketing and pricing structures in the computer field and, computer personnel needs are changing.

Bob believes more and more businesses that have been time-sharing a large computer will take to micros. A self-contained computer in the office can be more cost-effective for day-to-day computations and data processing while it serves as a fast-paced link to the large machines when the need arises. He says the present practice of connecting a large processor directly to the customer for interactive processing is not economical, and "a lot of time-share companies that do that now won't be in business as time-share companies in five or ten years."

And where computer systems traditionally are sold door to door by black-suited salesmen with a carefully prepared prospectus, now the business user is coming to the computer supplier to buy the product. Steve believes this local marketing concept, especially in smaller communities, will grow even stronger in the future. As the number of computer users grows, there will be increasing demand for hardware-software service packages from a local dealer.

The day is coming when the professional programmer comes into his own – a true professional like an accountant or attorney. These people are needed because programming continues to become more complex. "Because people's expectations are continuing to rise, programming complexity and programming difficulty are rising," Bob says.

But there's a thorny question in the programming field yet to be resolved. Developing good programming technique is only half the problem. It is just as important to have solid application knowledge. That's one reason he prefers that his customers do as much of their own data collection and preparation as they can, using a microcomputer. Because they know their own businesses better than anyone else, they can prepare data for high-speed, large processor runs better than anyone else – if they can develop adequate programming skills. A professional programmer, on the other hand, would have more programming

expertise but probably would lack intimate knowledge of individual businesses, which could hamper custom program development for a wide range of disciplines. "What makes a good programmer is the ability to solve problems in an abstract form," Bob states, "and very few people really are able to do that."

Because of this increased complexity, programming and other personnel costs are accounting for an ever larger share of total system cost. A few years ago computer hardware probably made up 50 percent of the cost of the complete system. Now, Bob figures hardware costs may be as low as ten percent, even though overall costs have continued to rise. At the same time, because users expect more from their machines and the hardware suppliers are coming very close to meeting these expectations, there is much higher quality programming now than ever before.

As the hobby machines move into the business world, some design changes should take place. Already much of the later hardware is more rugged than its predecessors, and that's a trend Bob would like to see continue. He'd also like to see a ninth parity bit routinely added to new memory circuits. "In the industrialization of these microcomputers, they're going to require self-diagnosing systems. Computers are perfectly capable of it. The big ones do it all the time."

The Computer Store doesn't sell many kit systems and doesn't advise anyone to purchase a computer kit. Their feeling is that the cost of building and troubleshooting usually is much greater than the savings on the original kit purchase. The people who build kits, they believe, do so to have fun. But don't buy a kit to save money, they advise, because you won't. If you're buying a computer for a dedicated business use, not just to play games or learn about hardware, you're much better off spending your building and troubleshooting time learning how to program the machine and put it to work for you.

The Computer Store's basic business system consists of an Altair mainframe, 48K of memory, dual disk drive, Lear Siegler TVT, DEC Writer II and one or more business software packages.

Virtually all of the business systems are delivered assembled and debugged. The average system carries a price tag of $7000 to $12,000. IBM-type service contracts are available, but are seldom needed. The Altair business software packages are powerful and functional, but they cost about $1500 each. They're not for the hobby market.

The Computer Store people would like to see the store's hobby market pick up (and they believe it will because of the large number of technical people working for such companies as Union Carbide in Charleston), but the real future of the microcomputer is in business and industry. "I'd say the euphoric aspect of this thing is past," Steve predicts." "Now it is time to get down to the nitty-gritty."

These people firmly believe in the future of computers in education, too. Bob feels children eventually will be using computers as most of us used slide rules or calculators. "All of the technology already exists for that now, but the software doesn't, nor does the teaching ability. Teachers of this generation haven't grown up on computers," he adds.

The Computer Store is doing its part to offset this deficiency. Early in the 1976 school year they placed two computer systems in Charleston high schools to give kids a crack at hands-on computer experience. Mary Lou worked with teachers on programming techniques. Now the state and city boards of education are interested in exposing more students to computers. If financing can be worked out for a time-sharing system that would allow five to ten students at a time to access each computer, every Charleston high school may soon have its own educational micro system.

The search for new markets goes on all the time. Jim Butch still works as a consultant with Preiser, where they're expanding the use of the Altair in the laboratory. Already Altair systems are being used to analyze coal for its energy-producing capability and sulphur and ash content. Jim would like to increase this type of consulting to provide regular custom applications to a broad base of West Virginia business and industry. He's working through a newly formed computer club to boost The Computer Store's hobby market.

Conclusion

So there you have a brief look inside one computer retail operation, a look that seems to indicate the potential for such businesses is just opening up. It shows, too, that those with an eye toward owning their own store had best move slowly, with full cognizance of the job before them. Even though the microcomputer business is booming and stands to do so for the foreseeable future, basic business principles can't be ignored.

Know your market. Decide who you'll be selling to and what kind of software and hardware you'll need. A retail computer store can be a viable operation in small communities, but you probably can't depend on hobby purchasers for the majority of your sales. With the right approach, however, business system sales are a very realistic prospect nearly anywhere. Bob Payne says the business market for microcomputers "hasn't even been touched; we haven't scratched the surface."

Know yourself. Do you have or can you secure the financial backing it will take to establish a store? Do you have the business savvy you'll need and do you have technical expertise to maintain equipment and do warranty work?

Know the franchisor. Be sure you understand all that will be required of you as their company representative and be clear on the company's position on equipment warranty, deliveries, inventories and cost. Some companies, for example, require a dealer to maintain a certain amount of stock for off-the-shelf delivery (a smart business practice, in any case). This can tie up considerable money, and if it isn't figured in your financing plan, this requirement could put a kink in your operation.

Obviously there's too much involved for this, or any other single article, to be a complete guide to setting up your own business. You can get more information from the Small Business Administration, Washington DC (start with SBA publication #71), and local financial institutions and business organizations. For anyone with the interest and ability, some form of the computer business could provide a successful future. Bob Payne compares the computer business to aviation, noting that modern aviation is just over two generations old. In that brief time we've come from the Wright brothers' first flight to men on the moon. Modern computers aren't through a single generation yet, putting them where aviation was perhaps 40 years ago: "Nowhere. Computing is nowhere right now. It's not even 30 years old yet," Bob says.

Where this fascinating field goes during the next 30 years depends largely on the expertise and dedication of those entering it today. That's an exciting challenge and responsibility none of us should take lightly. ■

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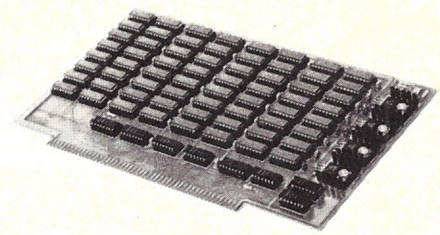

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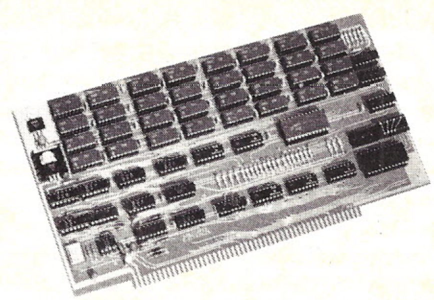

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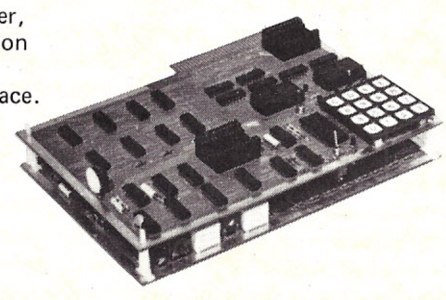


Kit $189.00   Assembled $299.00

Bill McLaughlin
Box 158
San Luis Rey CA 92068

ALL CAPS

. . . should be laid to rest

The following article on ALL CAPS contains excerpts from Bill's new book, BOSS: A Cost-Effective Business-Oriented Small Computing System, *about word processing using microcomputers. Sounds like somebody should do a review on it.*

And while we're on the subject of all caps . . . it's a no-no for manuscripts. — John.

Look at hobby computing today and you'll think you are watching a Keystone Cops movie: hobbyists heading in all directions, not aware of where they are going, or why, or what others are doing; running smack into each other; falling down; picking themselves up unhurt and continuing to race on in random directions.

Why do people buy those funny Teletypes and matrix printers?

"In order to get listings of their programs," you answer.

But, for the same amount of money, they could get something that produces good enough print quality to handle correspondence.

"A lot of people don't write letters," you say.

Why?

"Too tedious."

With a little help from their computers, maybe writing wouldn't be such a difficult task.

IBM calls that help "word processing," which today is certainly one of the most promising applications of small computing.

Granted, people buy computers so they can play blackjack and ticktacktoe like the other guys in the computer club, or to write the Great American Compiler, but they should select their hardware so their choices will broaden their activities, rather than limit them.

You don't write letters in all caps, or on rolls of newsprint, or with smudgy, heavy ribbon.

Unfortunately, many people buy those poorly designed printers and matrix devices because they want their work to look as though it were produced on a Big Computer (initial caps intended).

The phoniness of the "cult of all caps," the "slashes through 0s and/or 7s" crowd, reminds me of the days when I used to edit weekly newspapers in the suburbs. Housewives streamed in with press releases announcing that their little theater groups were holding coffee klatches to raise money to buy grease paint for their new productions. Invariably ALL CAPS! They had probably made ten attempts before remembering to unshift for all the numerals and special characters. I had to underline all the real capitals, and draw a slash through all the intended lowercase letters.

This is a caps-and-lowercase society. The British slash their 7s, and there are only certain instances when clarity is enhanced by slashing a 0. It is pretentious to use anything but the accepted 96-character alphamerics, and latter 20th-Century-American communications conventions. Any infractions are clearly cases of latent schoolgirl style!

Big Computers (an attitude, a cult — initial caps, please) frequently use all caps, and for seemingly good reason: Their machines are so inordinantly expensive and poorly planned. They have to cut corners with memory and output. It is pure affectation for hobbyists to copy the appearance of big-machine output, since small computers do not share any of the underlying system deficiencies that make such output degradation attractive to the big installation.

In Big Computers, mem-

ory and storage cost many arms and legs. By using all caps, six bits can do the work of eight. Packing algorithms yields further savings. Hobby computers use eight-bit memory, frequently stored in ten bits (Kansas City tape standard, for instance). Can you think of anything more ridiculous than using ten bits to store six-bit all-caps ASCII? Amateurs do it all the time.

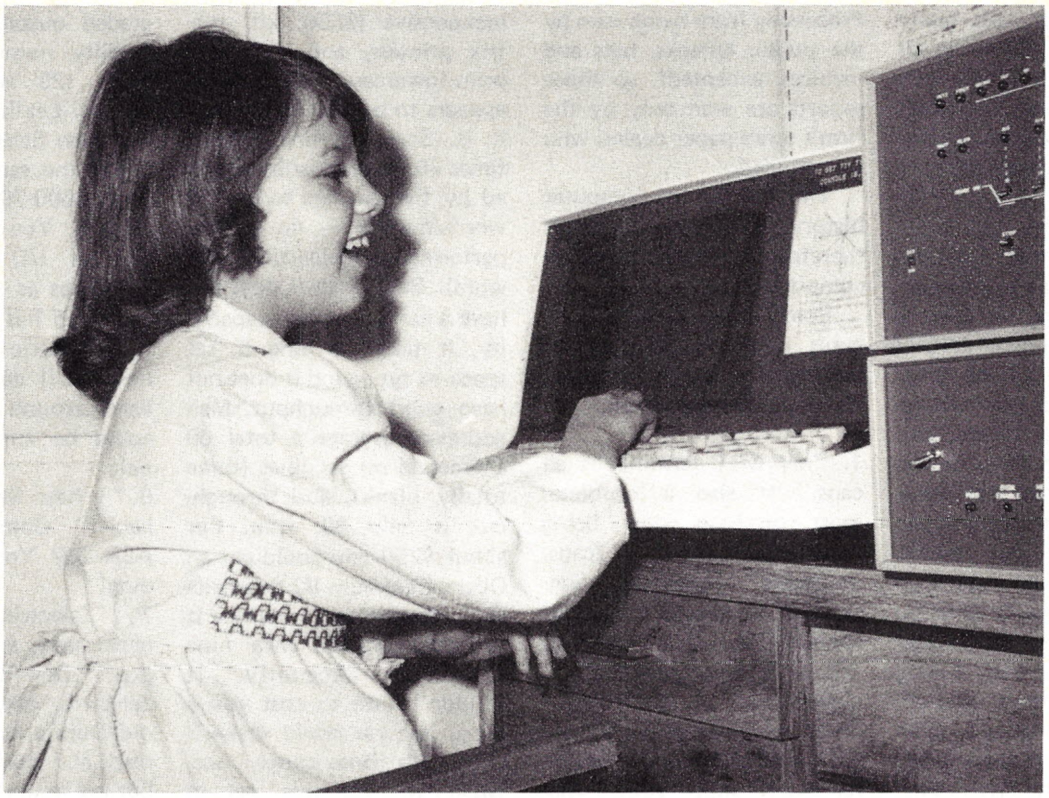
Big System people have an intense dislike of forests, and therefore weigh their words by the ton. Their computer centers are run 'round the clock, printing out reports that will never be read (systems analysts see to that by making them so unmanageably long). Besides saving memory and storage, the all-caps trade-off allows Data Processing to run its printers about 30 percent faster, so it can print 30 percent-longer reports, which are 50 percent harder to read.

Company policy prevents anything produced by Data Processing from being seen by the public (checks, bills and invoices excepted), so those reports are seen only by the firm's scrap-paper dealer, who cannot read.

Thirty years of computer history, written in All Caps, is therefore irrelevant to small-computer users.

Some representative excuses for using all caps, or semireadable matrix, or heavy ribbon or newsprint roll:

1. "My CRT terminal is all caps." It also is obsolete; most products now being announced have CLC (caps, lowercase) capability. Suggestion: Dedicate a special character to shift and unshift, and write a program that explains that to the printer. Then you'll be able to work CLC, and will have a constant reminder that your CRT needs updating.
2. "My keyboard doesn't shift." Fix it or chuck it. They are cheap.
3. "I got one of those fast, inexpensive ($250, kit) matrix printers, and it doesn't print lowercase." That device appears to be a lot faster than it is. Sure, 40 lines/minute times 40 characters/line divided by five appears to be 320 words/minute — no shabby performance (Selectric is 185 wpm). But, since it does not have a carriage-return capability, it takes as long to set space as type, and it does not have good throughput. Mail addresses average a total 60 characters on six lines (three totally blank), and throughput is only 80 wpm. For about $250 you could get an Olivetti Lexikon 82 Selectric-like portable and interface it to your system with nine solenoids. Actually, it wouldn't have to cost you a dime, as you could make a mint with those conversions. When you do this, get in touch with me.
4. "I got the heavy-ribbon machine, with newsprint roll, because it interfaces easily to my computer." Besides degraded output, you pay reliability, noise and speed penalties (25 wpm less than Olivetti Lexikon 82, 75 wpm less than Selectric). Cost was about the same as Selectric, and $600-700 more than Olivetti. You could have gotten an I/O Selectric that interfaces as easily as a Teletype and has beautiful type.
5. "Selectric has a bastard, non-ASCII code." There are ways around that, but that could be another whole article.
6. "I hear Selectric isn't reliable." Compared to the ASR 33? You must be kidding!
7. "Selectric doesn't read paper tape, and the ASR 33 does." See, there is another Selectric advantage! Those old Dura and Intel Selectrics read and punch paper tape, but are hard to interface. One is better off without paper tape.
8. "I got a Teletype Model 15 for $75." You paid far too much! ■



Julie and her "learning machine."

The "Learning Machine"

. . . math tutor program

Sanford P. Schumacher
President
Innovatrix, Inc.
Box 371
Ingomar PA 15127

As I recall, I learned *arithmetic* in grade school. Now it's mathematics or *math*. New or old, one of the jobs for grade school children is learning multiplication tables and simple division. It's nice to know how the tables relate to addition, etc., but sooner or later the kids need to memorize their tables (learn them by *rote*, as the psychologists say).

Except for the gifted few with photographic memories, rote learning is a pain. But learning psychologists have evolved a number of principles which facilitate rote learning. Among these are:

1. Keep the students actively responding (rather than just passively listening) but keep the activities directly related to the learning.

2. Provide lots of practice, practice, practice!

3. Minimize the practice on the trivial or easy (i.e., already known) portions, while providing extra practice on the portions that the student

does not know.

4. Provide strokes (gumdrops, reinforcement) for correctly learned portions, and immediate feedback about mistakes.

A good tutor can (and does) do all of these things in helping a child learn multiplication tables. However, few can afford tutors, and parents as tutors usually suffer from a couple of drawbacks. They can't always take the time necessary to provide all the practice needed, and their own frustrations (over the kid's mistakes) can send out all sorts of signals which inhibit learning.

A simple BASIC program for personal computers can serve these tutorial functions without some of the noted drawbacks of parental instruction. Program 1 is a BASIC program with the following features, many of which a good tutor would use:

1. The student's name is used occasionally throughout the learning session.
2. The student (or tutor) can select the type of problems to be worked — currently, multiplication or division.
3. The range of digits selected for the problems can be defined at the outset to accommodate students at different levels of competency.
4. The student can ask for his or her score at any time by pressing S.
5. Every correct answer is immediately reinforced when the program spits out a bunch of bells. On a random basis, the program also provides pats on the back in the form of written *nice* messages.
6. Most errors are acknowledged with *neutral* feedback (i.e., "Try again"). Occasionally, slightly negative feedback is given (i.e., "Not too good," or "You should know better").
7. The same problem is immediately repeated whenever the student makes a mistake.
8. The missed problem is remembered and repeated a little later, with the dividend and divisor (or whatever) interchanged.

A run of the program in Fig. 1 illustrates most of these features.

How effective is the program? I'm biased. In fact, my only test was on my daughter Julie, age nine. When Julie received the assignment to learn the tables, I worked with her off and on for an entire weekend. I promised her $2.00 if she'd learn the two through nine tables perfectly. She tried hard and did learn the "easy" ones pretty well. But the tables above five were a disaster.

So I created the tutor program. Julie used it in three or four half-hour sessions. On the last try she did 100 multiplication problems without error. Her reward? One large gumdrop. (Literally!) My reward was to see how happy and proud she was.

This tutor program evolved to fit our specific needs. But with some minor changes a lot of other things could be done. I'm working on three modifications now, and thinking about some other exciting additions which should further enhance the learning process. The three I'm currently writing are:

```
RUN
WHAT'S YOUR NAME? SANDY
SANDY, DO YOU WANT DIRECTIONS? NO
PRESS ANY KEY? Q
MULTIPLICATION OR DIVISION? DIV
DO YOU WANT TO ADJUST RANGE? NO

 72 / 8 =? 9
GOOD FIGURING SANDY

 48 / 8 =? 6

 36 / 6 =? 4

SANDY, YOU SHOULD KNOW BETTER!

 36 / 6 =? 6

 63 / 7 =? 9
GOOD FIGURING SANDY

 36 / 6 =? 6

 36 / 6 =? 6
YOU GOT IT!
... BUT IT WAS EASY!

 48 / 6 =? 8

 42 / 6 =? 7
YOU GOT IT!

 48 / 8 =? 7

TRY AGAIN

 48 / 8 =? S

 8 CORRECT
 2 WRONG
 80 %
HERE'S YOUR PROBLEM AGAIN, SANDY

 48 / 8 =?

OK
RUN
WHAT'S YOUR NAME? THE GREAT PUMPKIN
THE GREAT PUMPKIN, DO YOU WANT DIRECTIONS? NO
PRESS ANY KEY? A
MULTIPLICATION OR DIVISION? M
DO YOU WANT TO ADJUST RANGE? YES
TOP OF X RANGE -- A DASH -- BOTTOM OF X RANGE? 12-6
TOP OF Y RANGE -- A DASH -- BOTTOM OF Y RANGE? 6-2

  7
X 6
----
=? 42
YOU GOT IT!

  8
X 5
----
=? 40
THE GREAT PUMPKIN, YOU'RE A WIZZ

  11
X 5
----
=? 66

TRY AGAIN

  11
X 5
----
=? 55

  9
X 4
----
=? 36

  5
X 11
----
=? 55
YOU GOT IT!

  9
X 5
----
=? 45

  9
X 4
----
=? S

6 CORRECT
1 WRONG
85 %
HERE'S YOUR PROBLEM AGAIN, THE GREAT PUMPKIN

  9
X 4
----
=?

OK
CONSOLE16,10
```

Fig. 1. Sample run of program (multiplication and division).

1. Segments for addition or subtraction.

2. A routine to keep track of how many times a specific problem is given and answered correctly. After any particular problem is correctly answered, say, three consecutive times, it will not be presented again. In this way, extensive practice of already learned problems can be avoided.

3. A routine to store the first N problems that are missed. The student will be able to replay all missed problems on demand.

The program as it stands has several interesting features. One of these is the use of Mits' INSTR function to allow input of both numbers of the range during one INPUT. This feature, in Extended BASIC, would be difficult to accomplish in ordinary or Tiny BASIC; but the same purpose (adjusting the range) could be easily accomplished with several INPUTS in any BASIC.

The program also illustrates an approach for cutting down stilted, totally repetitive computer responses to correct answers. This is accomplished in the subroutine starting at line 300. First, a message is feasible only seventy percent of the time (line 300). To provide variety, the messages are chosen on the basis of the value of the divisor (or multiplicand) which was determined randomly. To further mix it up, the routine at line 302 changes things around a bit more so that different messages are presented for the same divisor or multiplicand.

Of course, my purpose in writing Tutor was not to develop the perfect or totally efficient program. I wrote it to help my daughter learn her math. Admittedly, developing and debugging it was fun, but watching how easily and totally Julie learned her multiplication tables was the real payoff. ■

```
1 INPUT"WHAT'S YOUR NAME";N$:PRINTN$;", DO YOU WANT DIRECTIONS";:  INPUT
T$:IF LEFT$(T$,1)="Y"THEN GOSUB400: REM*** MATHEMATICS TUTOR  BY  S.P.
SCHUMACHER      3222      BYTES MITS BASIC. JANUARY, 1977. HERE COME THE
INPUT QUESTIONS. SEE DIRECTIONS***
2 INPUT"PRESS ANY KEY";R$:FORI=1TOASC(R$):X=RND(1):NEXTI
3 INPUT"MULTIPLICATION OR DIVISION";T$
4 INPUT"DO YOU WANT TO ADJUST RANGE";R$:IFLEFT$(R$,1)="N"THEN9ELSEIFLEF
T$(R$,1)<>"Y"THEN4
5 INPUT"TOP OF X RANGE - - A DASH - - BOTTOM OF X RANGE";TX$
6 INPUT"TOP OF Y RANGE - - A DASH - - BOTTOM OF Y RANGE";TY$
7 TX=VAL(LEFT$(TX$,INSTR(TX$,"-"))):BX=VAL(RIGHT$(TX$,LEN(TX$) - INSTR(TX$
,"-"))):TY=VAL(LEFT$(TY$,INSTR(TY$,"-"))):BY=VAL(RIGHT$(TY$,LEN(TY$) - INS
TR(TY$,"-"))):IFTX<BXORTY<BYTHENPRINT"ILLOGICAL: ";:GOTO5
8 GOTO10
9 TX=9:BX=6:TY=9:BY=6:REM ***SETS RANGE FOR X & Y IF NOT INPUT AT 5&6***
10 F=F-1:IFF=2THENX=Z2:Y=Z1:IFLEFT$(T$,1)="M"THEN30ELSE22
14 REM ***15 & 20 PICK A RANDOM VALUE FOR X & Y***
15 X=INT((TX-BX+1)*RND(1)+BX)
20 Y=INT((TY-BY+1)*RND(1)+BY)
21 IFT$="M"THEN30
22 DD=X*Y:PRINT""
23 REM ***ACCEPT DIVISION***
24 PRINTDD;"/"X;"=";:INPUTA$:A=VAL(A$):IFA$="S"THEN200
25 IFA*X=DDTHEN70ELSE80
29 REM ***ACCEPT MULTIPLICATION***
30 PRINT"    ";X:PRINT;
40 PRINT"  X";Y:PRINT;
50 PRINT" -----":PRINT;
60 INPUT"=";A$:A=VAL(A$):IFA$="S"THEN200
65 IFA=X*YTHEN70ELSE80
69 REM ***RING THEIR LITTLE CHIMES. KEEP TRACK OF 'RIGHTS' AND FLAGS***
70 FORM=1TO25:PRINTCHR$(7);:NEXT:R=R+1:F=F-1:GOSUB300
75 IFA=X*YTHEN10
76 IFA*X=DDTHEN10
79 REM ***KEEP TRACK OF 'WRONGS' AND PICK A NO-NO MESSAGE***
80 W=W+1:PRINT:IFX=TXTHENPRINT"NOT TOO GOOD ";N$
85 IFX=BXTHENPRINTN$;", YOU SHOULD KNOW BETTER!"
90 IFX<TXANDX>BXTHENPRINT"TRY  AGAIN"
91 REM ***SET UP FLAGS AND THINGS SO WRONG PROBLEM CAN BE REPEATED***
92 F=6:Z1=X:Z2=Y
95 PRINT:GOTO21
199 REM  ***GIVE THEM THE NEWS***
200 S=(R/(R+W))*100
205 PRINT
210 PRINTR;" CORRECT"
220 PRINTW;" WRONG"
230 PRINTINT(S);" %"
233 PRINT"HERE'S YOUR PROBLEM AGAIN, ";N$
235 PRINT
240 GOTO21
299 REM ***SELECT THE GOODIE MESSAGES***
300 IFRND(1)>.7THENPRINT:RETURN
302 IFRND(1)>.4ANDX<TXTHENX=X+1:ST=1
305 IFX=BXORX=BX+1THENPRINT"YOU GOT IT!";
310 IFX=BX+2THENPRINT"GOOD FIGURING ";N$;
315 IFX=BX+3THENPRINTN$;", YOU'RE A WIZZ"
316 IFX=>BX+4THENPRINT"ANOTHER RIGHT ANSWER, ";N$
340 IFX=YANDQ<.4THENPRINT" ... BUT IT WAS EASY!":Q=1:PRINT:ELSEPRINT
342 IFY=X-1ANDST=1THENPRINT" ... BUT IT WAS EASY!":Q=1:PRINT:ELSEPRINT
345 IFST=1THENST=0:X=X-1
350 RETURN
360 REM ***MORE TO COME***
400 PRINT"THIS PROGRAM WILL HELP YOU LEARN MULTIPLICATION AND DIVISION."
410 PRINT"THINGS YOU HAVE TO DO TO GET STARTED ARE:"
420 PRINTTAB(5)"1. PRESS ANY LETTER OR NUMBER KEY AND THEN 'RETURN'."
430 PRINTTAB(5)"   THIS MAKES SURE YOU START WITH A NEW BUNCH OF  "
440 PRINTTAB(8)"PROBLEMS.":PRINT
450 PRINTTAB(5)"2. TYPE 'M' OR 'D' FOR MULTIPLICATION OR DIVISION."
460 PRINTTAB(8)"THEN 'RETURN'. (YOU ALWAYS PRESS RETURN TO LET THE COM-"
470 PRINTTAB(8)"PUTER KNOW YOU'RE FINISHED TYPING.":PRINT
480 PRINTTAB(5)"3. IF YOU WANT THE RANGE OF NUMBERS IN YOUR PROBLEMS T
O"
490 PRINTTAB(8)"BE DIFFERENT THAN 6 TO 9, THEN TYPE 'Y'. IF YOU LIKE 6"
500 PRINTTAB(8)"TO 9 TYPE 'N'. IF YOU WANT TO CHANGE THE RANGE, TYPE"
510 PRINTTAB(8)"THE LARGEST VALUE FIRST, THEN TYPE A DASH, THEN TYPE"
520 PRINTTAB(8)"THE LOWEST VALUE. YOU'LL HAVE TO DO THIS TWICE. ":PRINT
530 PRINT"JUST DO THE ABOVE STUFF TO ANSWER THE COMPUTER'S QUESTIONS."
540 PRINT"DON'T FORGET TO PRESS 'RETURN'!"
550 PRINT:PRINT"AS YOU ARE GIVEN A PROBLEM, TYPE IN YOUR ANSWER. IF"
560 PRINT"YOU ARE RIGHT THE COMPUTER WILL RING A BELL.IF YOU ARE WRONG,"
570 PRINT"IT WILL GIVE YOU ANOTHER CHANCE.":PRINT
580 PRINT"ANYTIME YOU WANT TO SEE YOUR SCORE, JUST TYPE 'S' INSTEAD"
590 PRINT"OF YOUR ANSWER. GOOD LEARNING, ";N$:PRINT:PRINT:RETURN
600 END
```

Program 1. Program listing.

You Asked For It!

You asked for the Intel 8080A CPU . . . . We gave you the VECTOR 1

You asked for a real-time clock . . . . We gave you the VECTOR 1

You asked for eight level vectored priority interrupts . . . . We gave you the VECTOR 1

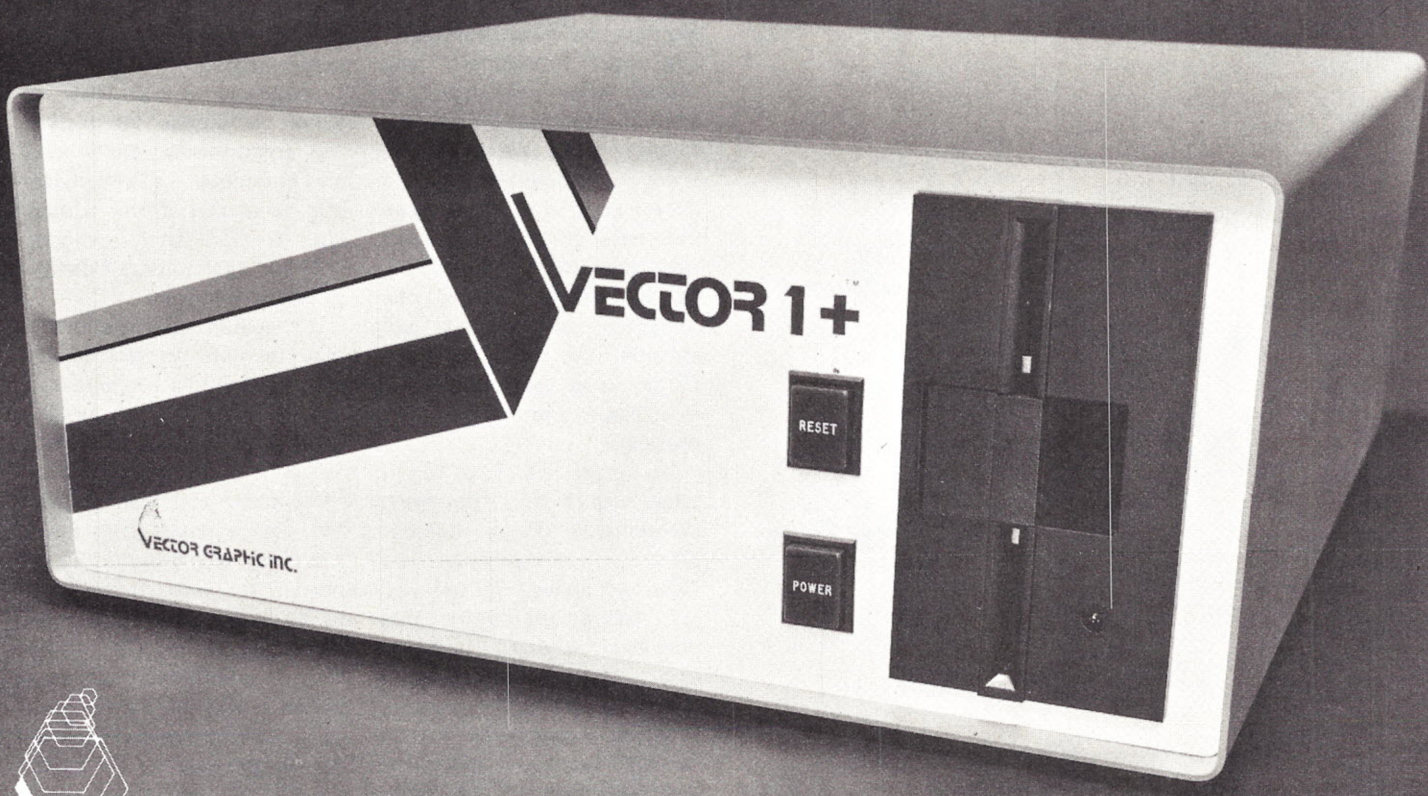
You asked for a jump-on-reset and resident monitor . . . . We gave you the VECTOR 1

You asked for the S-100 bus . . . . We gave you the VECTOR 1

You asked for an 18 slot fully shielded motherboard . . . . We gave you the VECTOR 1

You asked for a rugged, reliable chassis . . . . We gave you the VECTOR 1

Then . . . You asked for the compactness and convenience of installing your mini-floppy disk directly in the front panel . . . . NOW . . . We give you the VECTOR 1+



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KILOBAUD KLASSROOM NO. 7

. . . transistors, diodes and op amps

George Young
Sierra High School
Tollhouse CA 93667

At approximately the halfway point in this series, it is appropriate to take a look at what we've done and what remains to be done. In the preceding six sessions, we have been building our foundation, and should have gained a substantial background in the simpler gates. We have also spent considerable time on power supplies — because no electronic circuitry will function correctly without the correct power. During the remaining sessions, we will consider the more complex IC packages and how they interrelate with the microprocessor.

In session No. 1, in May, I asked you to start scrounging components from defunct electronic equipment. The time has arrived to tell you how to test the components you have salvaged. Learning how to test these components relates directly to troubleshooting a computer that is "down" because of defective hardware. Some of the techniques presented here have been described earlier in the series. Nevertheless they will be repeated. One of the cardinal rules of education is that of repetition — repeat things often enough, and all students will progress.

A second topic for this session will be operational amplifiers, or op amps. At first glance, op amps would seem to have no place in a course on digital electronics. Not so; they are used in cassette interfaces and in some computer power supplies.

Finally, we are going to give you still another clock circuit. This one uses three transistors to generate pulses, and can be added to your circuit collection to use when you need a clock but don't happen to have the ICs handy to fabricate one.

Experiment #32 Diode and Transistor Testing

Problem: a. I have all this stuff in my junk box that Young asked me to start salvaging back in session No. 1. How can I determine what is usable and what should be discarded? b. My computer is down; I need to troubleshoot it and locate the defective components.

Solution: Let's look at some techniques for testing the components. We'll need an ohmmeter, a voltmeter, the Squawker from session No. 5 (*Kilobaud*, October '77) and the Student Console or Design Console.

Procedure: The ohmmeter may be used to test diodes and transistors "out of circuit." Set the ohmmeter on the R x 10 (or higher) range. The R x 1 range of some ohmmeters can destroy the device under test. Place the ohmmeter ground clip on one of the leads of the device to be tested. Place the ohmmeter probe on the other lead. The ohmmeter will read either a low resistance or a very high resistance. Reverse the ground clip and the probe connection. Again the ohmmeter will read either a low

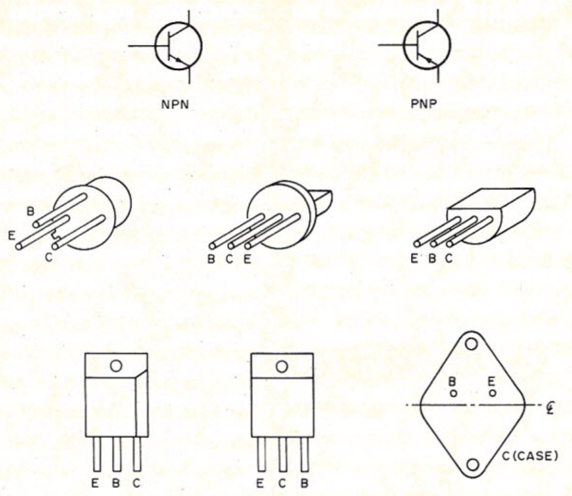


Fig. 1. Transistor symbols and basing.

or high resistance, but it should be the *opposite of the initial resistance measured.* If the resistance measures the same in both positions of the meter connections, the diode or transistor is most likely defective.

Fig. 1 gives some of the common transistor basings. Fig. 2 is a pictorial representation of the ohmmeter test just discussed.

Salvaged diodes, transistors, resistors and capacitors present a problem for us as far as plugging them into our solderless breadboard is concerned. They have solder on the leads, which enlarges the lead diameter and can also come off inside the contacts of our breadboard, causing further problems. If you attempt to melt off the excess solder, I think you will be disappointed in the results. Try this technique: Using the flat, nonserrated portion of the jaws of your long-nose pliers, crush the solder several times as you rotate the lead. This weakens the solder considerably. Now, using the serrated portion of the long-nose jaws, gently squeeze the pliers as you rotate the lead. Easy does it; we don't want to twist the lead off, just clean it up. The weakened solder will peel off the lead, leaving it clean and at its original diameter. This procedure can be used on the leads of diodes, resistors, capacitors and transistors, and should be used on any leads of previously soldered components prior to their insertion in the solderless breadboard.

Diode and Transistor Junctions

Diodes and transistors are made by a process called doping. Starting with pure germanium or silicon, both of which are insulators, a small quantity of atoms is added. Certain atoms cause the formation of negative (N) material; others will produce positive (P) material. Adding these atoms, which are impurities, is called doping and changes the insulators to semiconductors.

When both types of atoms (P and N) are added to pure silicon or germanium, we form what is called a PN junction. In Fig. 4, the N material is depicted as having a negative charge, or a *surplus of electrons*, while the P material is depicted as having a *shortage of electrons* and is characterized by the positive charge. The area between the positive and negative charges is the junction.

A diode has only one PN (or NP) junction. A transistor has two junctions and is either NPN or PNP. A transistor, therefore, can be considered as two diodes back to back. Fig. 5a shows the two-diode configuration for the PNP transistor, and Fig. 5b shows the NPN two-diode configuration, with A = anode and K = cathode. We make use of this two-diode back-to-back concept of transistors for our testing of transistors. As we shall see, it is possible to use this concept to determine if the transistors are good; which leads are emitter, base, and collector; and even to determine the material, germanium or silicon, from which the transistor was made.

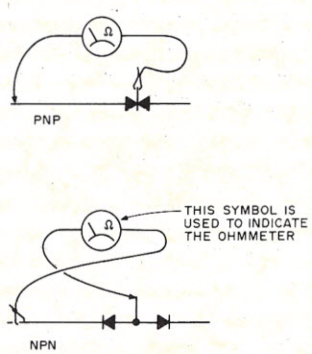


Fig. 2. The ohmmeter test circuit.

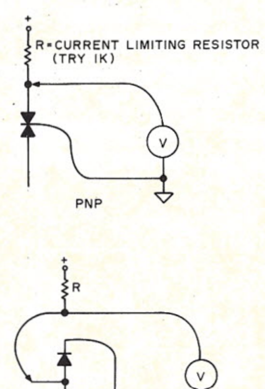


Fig. 3. The voltmeter test circuit.

The Theory of Ohmmeter Testing

An ohmmeter contains an internal power source, usually a battery, to provide the current necessary for making measurements of resistance. When the ohmmeter is placed on its R x 1 range, it delivers maximum current to the resistance under test. When it is placed on any higher range, additional resistance is placed in the ohmmeter circuit. Therefore, diodes and transistors may be destroyed if tested on the ohmmeter's R x 1 range. Always use the R x 10 or higher range for initial testing.

Back to the solderless breadboard. If the ohmmeter reads a very high resistance, or infinity, the diode junction under test is reverse biased and is not conducting. This statement is true for a diode or for the diode junction of a transistor. Reversing the ohmmeter connections to the diode junction will therefore forward bias it; the junction will conduct and the ohmmeter will display some value of resistance. The exact value of this resistance is not significant at this point. Connecting the internal battery of the ohmmeter one way forward biases the junction under test, while reversing the battery connections reverse biases the junction and it does not conduct.

But which way is which? Some ohmmeters have the positive end of their internal battery connected to the probe, while in others it is connected to the meter ground clip. We can determine which way the internal battery is connected without opening the meter case. Use a marked diode to make the ohmmeter test so that you know which is the cathode and which is the anode. (The

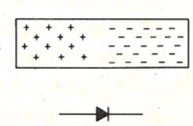


Fig. 4. One representation of P and N material.

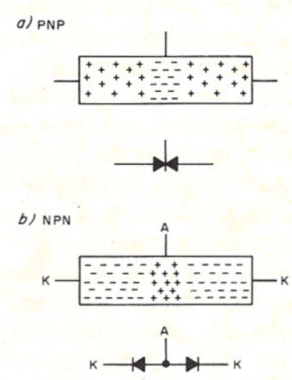


Fig. 5. Representing PNP and NPN transistors as diodes.

cathode end is marked with a band or the diode symbol.) Connect the ohmmeter leads so that the clip is on the cathode and the probe is on the anode. If the diode conducts, as evidenced by a resistance reading on the ohmmeter, then the internal ohmmeter battery is connected with positive to the probe and negative to the ground clip. We can therefore memorize the following rule:

A diode is forward biased and conducts with the ground clip of the ohmmeter connected to the cathode and the probe connected to the anode.

If your particular instrument works exactly opposite, simply interchange the words anode and cathode, and then memorize the rule for your meter.

Transistor Base Lead Identification

Refer again to Fig. 2. Connect the ground clip of the ohmmeter to one of the transistor leads. Now touch the probe to each of the remaining two transistor leads. Suppose the ohmmeter conducts in both cases. The ground clip is on the base lead, and the transistor is a PNP type. Reverse the ohmmeter connections by placing the probe on the lead just identified as the base of the transistor. Touch the ground clip of the ohmmeter to each of the other two leads. In each case, the ohmmeter should read a very high resistance, or infinity. The transistor is good.

Suppose, however, that you make the above test and find that two diodes inside the transistor package conduct with the ohmmeter probe connected to one lead when the ground clip is touched to the remaining two leads. Reversing the leads again gives a very high resistance for both the internal diodes. The probe is now on the base lead; the transistor is an NPN type and it is good.

These two tests assume that your ohmmeter fits the rule stated previously. If your particular instrument has the internal ohmmeter battery connected in reverse, the test can still be made, but the identification of PNP and NPN types will be reversed. I find that the best procedure is to test a marked transistor whose type is known, then memorize the relationship for this type of transistor and your ohmmeter. When the device under test is opposite to the relationship memorized, you know the device is an opposite-type transistor.

Some ohmmeters have a switch associated with the dc function of the instrument. It will usually be marked dc+ and dc-. On some instruments, the connections to the internal ohmmeter battery are also reversed when the switch is changed from dc+ to dc-. If your instrument has this switch, check to see if changing its position causes the battery polarity to reverse. You should be aware of this possibility so that you don't at some later date identify several transistors incorrectly. If your ohmmeter has the switch, you can use it to make your instrument match the aforementioned rule.

Suppose that when you test a transistor, one diode is good and the other is bad. The bad transistor can be discarded, or the good diode may be saved. Cut the lead of the defective diode off close to the case to avoid inadvertently using the defective transistor for anything but a diode.

Using the Squawker Instead of the Ohmmeter

The test instrument called the Squawker (*Kilobaud* No. 10) is quite versatile. You won't appreciate one until you have used it. The Squawker can also be used to test transistors and diodes, both in and out of circuit. Place the two Squawker leads across the diode or transistor to be tested, and then reverse the connection. In one direction the Squawker will sound off; in the other it will remain silent.

One caution should be pointed out: The Squawker uses a 9 volt battery as its power supply. It is possible for this voltage to destroy the device under test. I have tested thousands of diodes, transistors and ICs with my Squawker and have yet to damage one. Murphy's Law (If anything can go wrong, it will) to the contrary, I continue to use the Squawker in place of an ohmmeter for testing everything except CMOS devices.

Identifying Transistors with the Squawker

The Squawker can also be used for transistor base lead identification. Wired exactly as shown in the schematic diagram in session No. 5, with a red insulator placed on the positive lead from the internal battery, the Squawker will behave exactly according to our rule. That is, with the black clip lead connected to the base lead of the transistor, the Squawker will sound off as the red clip is touched to the remaining two leads of the PNP transistor. Reversing these connections will produce silence if the transistor is good.

This test can be performed "in circuit" or "out of circuit." The ohmmeter test does not always function on transistors and diodes while they are still connected into the circuit because they always have biasing and load resistors connected as well. The Squawker seems to ignore that the device still has resistance connected and, therefore, can be used to test diodes and transistors while they are still connected in circuit. Sometimes the Squawker will find an alternate current path through a large capacitor or the power supply and reject a good junction. When this happens, the device should be tested out of circuit before you throw it away as defective.

Identification of the Remaining Transistor Leads

Identification of the base lead of an unknown transistor is much easier than the identification of the remaining leads. If the transistor basing is standard, as in the TO-5 package (a metal can about one cm in diameter and one-half cm tall), identification of the leads is not a problem. This basing is shown in Fig. 1 at the left of the middle group of three transistors. The problem occurs with those transistors that have all three leads in line and equally spaced.

In power transistors, the collector lead is *usually* connected to the tab heat sink or to the case. The ohmmeter or the Squawker will, therefore, show a dead short (zero Ohms for the ohmmeter, no change in tone for the Squawker) from one lead to the heat sink tab or the case. In these cases, this allows us to identify the collector lead and, since only one lead remains, the emitter lead as well.

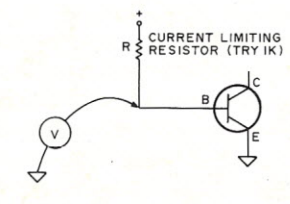


Fig. 6. The base-emitter zener test circuit.

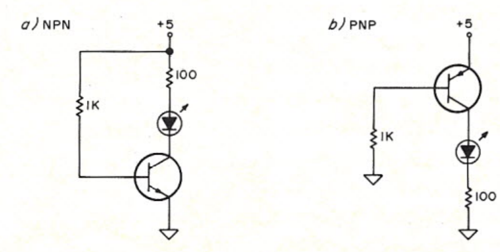


Fig. 7. Go no-go transistor testers.

There is still another way for us to identify one of the remaining two leads of a transistor so we can determine which is the collector and which is the emitter. This method makes use of something I used earlier in the series. The base-emitter junction of a silicon transistor acts like a zener diode in the 4-10 volt range. If you still need to identify the leads of your unknown transistor, connect it as a zener diode, as shown in Fig. 6. If it is silicon, and a zener, then you have all three leads of the device identified.

Go No-Go Transistor Tests

Problem: Okay, Young, now that you have spent all this time on how to identify the various leads of unknown transistors, can I have a simple circuit that will not only identify the transistor type, but will tell me if it will work after I solder it in to a circuit?

Solution: Fig. 7 gives a simple go no-go circuit that can be set up on the Student Console breadboard and used to quickly identify and test all the transistors that you have accumulated.

Procedure: Set up both circuits shown in Fig. 7 on the breadboard. Plug in the transistors to be tested. Having previously identified the base leads, the unknown device need now only be tried two different ways. If the transistor is good, the LED will light. If it does not light up, then either the transistor is bad, it isn't a transistor (it might be an SCR, for example) or you don't have the thing connected correctly.

Theory: A transistor in a computer is almost always used as a switch; it is either on or it is off. The 1k resistor in both circuits of Fig. 7 turns the transistor on, which effectively connects emitter and collector, allowing current to flow through the transistor and light the LED. Many computers used this technique in years past to

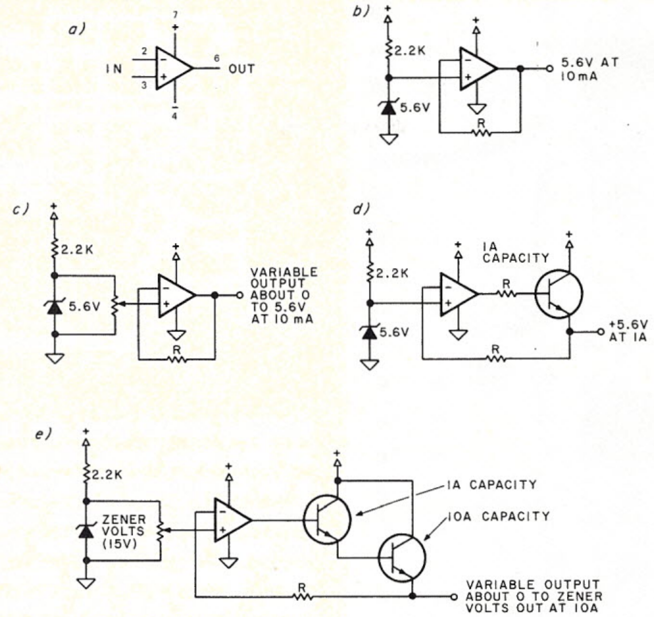


Fig. 8. Operational amplifier circuits for Experiment #33.

switch the front panel LEDs off and on. (ICs are used in today's circuits.)

Operational Amplifiers

Operational amplifiers, or op amps, are finding use in our computers. Cassette interfaces by several different manufacturers use them. Power supplies by at least two different manufacturers make use of them, and you will find them in analog-to-digital converter circuits as well. The 723 voltage regulator IC is an example of a chip that uses an op amp for its regulation. Fig. 8a gives the general symbol for the op amp. Note that two power-supply sources are indicated: one positive and one negative voltage source. An op amp may be operated with only a positive source and ground connected to the negative power-supply terminal. They were intended, however, to be operated from two different power supplies. There are some new op amps that are designed to be operated from a single-polarity power supply.

For this class, we will use a general purpose op amp and operate it in a power supply configuration, since I feel that this is the easiest way to get the feel of the op amp circuit.

Experiment #33
The Op Amp

Problem: How can I get a handle on an op amp?

Solution: Let's take one and put it on the console breadboard, and then let's experiment with it.

Procedure: Insert an op amp in the console breadboard. The circuit diagram of Fig. 8b shows a 741 type op amp. We will operate the device with a single power supply. Attach a wire under the chassis to the unregulated positive output of the console power supply in the same manner that we did for the earlier experiment on the SCR. Make this wire long enough to reach any of the plug-in locations on the breadboard.

Connect the circuit that is shown in Fig. 8b. It is possible for the zener to be any value less than the output of the unregulated output of the console power supply. Fig. 8b shows a 5.6 volt zener. The resistor shown as R may be any value that you have available between zero and about 4.7k Ohms. Use something in the vicinity of 2.2k for the zener current-limiting resistor.

Measure the output voltage of the circuit with a voltmeter. It should be the same as the zener voltage.

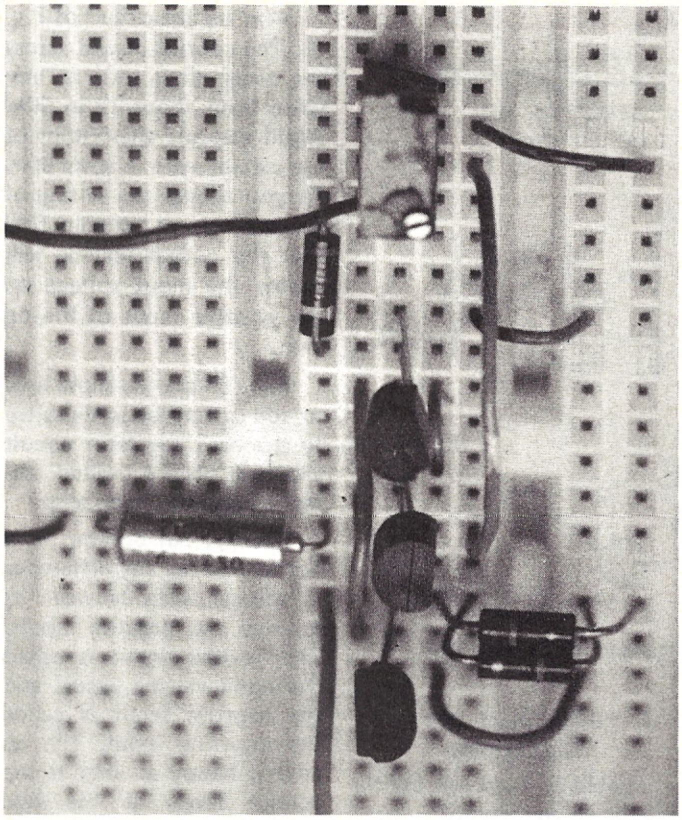
Now try the circuit of Fig. 8c. The control placed across the zener diode may be any value from about 1k to 50k. Again measure the output of the circuit with a voltmeter. As you change the setting of the control, you should find that the output voltage will follow the input voltage on the positive input of the op amp.

Figs. 8d and 8e show how to add current-boost circuitry to the basic regulator circuit and beef up the limited current output of the op amp.

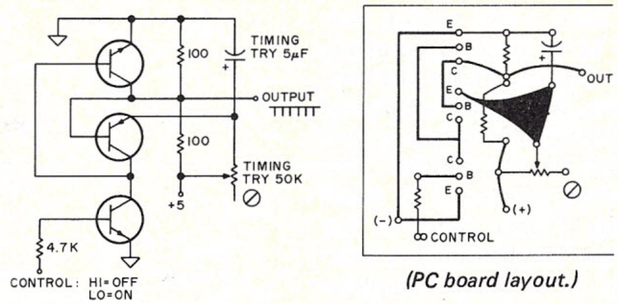
Theory: An op amp does not like to see any difference in voltage levels between its positive and negative inputs. The positive input is called the non-inverting input, and the negative input is called the inverting input. The op amp is happy as long as the voltage levels at the two inputs are identical. Whenever voltage difference exists at its two inputs, the op amp will attempt to adjust its internal operation to correct this situation. If we apply 5.6 volts to the positive input, it will adjust its internal amplification so that it also sees 5.6 volts on its negative input as well. If we connect the output back to the negative input, either through a resistance or even with a direct wire, the op amp will compensate itself so that no voltage difference exists between the positive and negative inputs.

Any change in the output level is fed back to the input, and the op amp immediately corrects internally for this change so that no difference will exist between inputs. Thus, voltage regulation.

The output of the 741 or any similar op amp is about 10 mA or so. This current level is too low for practical use. Fig. 8d shows how to add a current-boost transistor to beef up the output. The output of Fig. 8d will still be 5.6 volts, even though we have dropped 0.6 volts across the B-E junction of the booster transistor. Remember



The three-transistor clock circuit set up on the breadboard.



(PC board layout.)

Fig. 9. Three-transistor clock circuit.

that this junction is a diode, it is silicon, and silicon diodes will show a voltage drop of about 0.6 volts when they are forward biased. Use the voltmeter to measure the voltage at the output of the circuit and of the op amp. You should find that the output of the circuit is still the zener voltage (5.6 volts if you used a 5.6 volt zener), and that of the op amp has increased by 0.6 volts, or now measures about 6.2 volts. The op amp has adjusted its internal operation so that it sees no voltage difference between its positive and negative inputs. The base current-limiting resistor of Fig. 8d may again be almost any value that you have available (470 Ohms or 1k will be fine). You should also be able to use the circuit with no resistor at all in series with the base lead of the booster transistor.

Fig. 8e shows still another boost transistor added to the basic circuit. The value of the zener has also been increased in Fig. 8e. This circuit will not function now on your console breadboard unless you can raise the unregulated input to the circuit up to around 20 or 22 volts. Fig. 8e shows you how to make a variable, regulated 10 A output power supply using the op amp as the regulator element.

Design Considerations

How can you determine if your circuit design will survive? Connect your circuit and apply power. Smoke definitely means deficiency someplace in the design. No smoke? Good. Now take your patient's temperature. Place your finger on the device in question and see how hot it is. If the device is warm, but not so hot that you can't keep your finger on it, then your circuit will probably survive. This is a crude test, but it works. If the circuit runs cool, then your design is OK and will most likely survive for a long time.

Experiment #34
A Transistor Clock Circuit

Fig. 9 is a three-transistor clock circuit, originally designed several years ago for an electronic keyer. Connect it on the console breadboard. Almost any transistors may be used, but I have had the best results using the silicon type. Note that the circuit uses two NPN transistors and one PNP transistor. The circuit values are noncritical. The two resistors labeled as 100 Ohms should be of equal value, but may have any value between 100 and about 470 Ohms. The lower transistor in the circuit is a switch, allowing you to turn the clock on and off with a voltage. The current-limiting resistor on the base of this transistor may be any value between 1k and 47k. Vary the size of the control in the circuit and/or the size of the capacitor to change the output clock frequency. Use the output to clock a 7473 flip-flop, and then use the console logic probe to watch the flip-flop being toggled by the three-transistor clock circuit.

Preview

In the next session we will go into wave shaping. We will experiment with Schmidt triggers, monostable multivibrators, "cheap shots" and so forth. You will need at least one member of the Schmidt-trigger family of chips, a 7413, 7414, 74132, 74232 or any other chip that has hysteresis built into it. You will also need a member of the multivibrator family, a 74121, 74122 or 74123, as examples. In addition, you will need at least two 7490s, a 7404 and a 7400. The last two should already be in your possession from the earlier experiments.

As I mentioned last time, we are going to need an oscilloscope — which most of you will not have. I repeat, please do not run out and buy one. Let us *now* find that *resource person* I told you to locate earlier in the series, or make arrangements with your local high school or junior college to use one of their scopes.

If you know how to use a scope, great! If not, you will need to find one *and* the resource person to help you learn how to observe what will be happening in your next series of experiments. If you remain in electronics, you will eventually own a scope. For now, we want you to get some help on how to use one, and find out what a good scope is like, so that when you do buy your own you will know what you want and need.

I will attempt to teach you a little about a scope via *Kilobaud*. However, I am fairly sure I will fail miserably. I do not think it is possible in print to teach someone how to use one. My own students, both high school and adult, find its use is the most difficult aspect of electronics to learn. I'm reasonably sure most other instructors will agree that about the only way for anyone to learn to use an oscilloscope is by experience.

Sierra Electronics, Box 11, Auberry CA 93602, has agreed to package the active components we need for the next class session for $5 postpaid, U.S. and Canada. California residents must add 6% sales tax. ■

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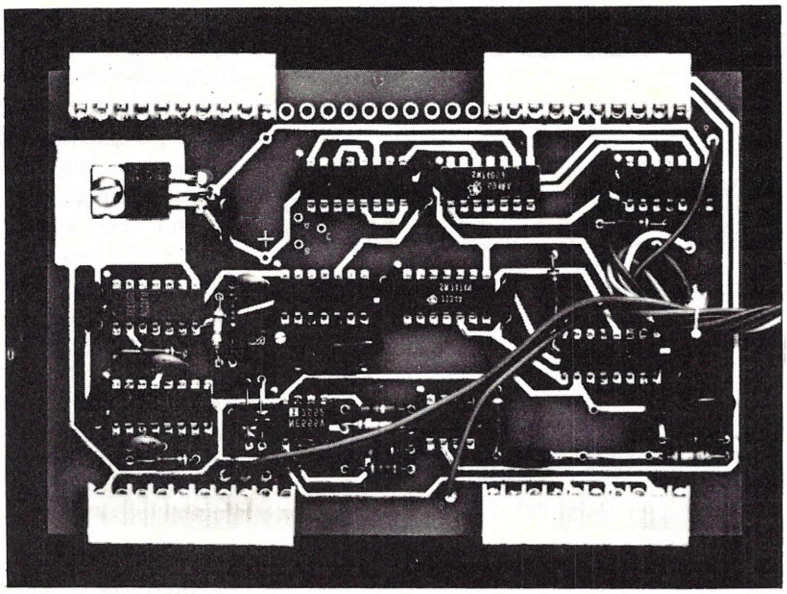
HERE IS THE BEST BUY ANYWHERE ON A CASSETTE INTERFACE: ACI-33



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SPECIFICATIONS

MODEL NUMBER:	ACI-33
FUNCTION:	Record and play digital data to computer using an ordinary cassette tape recorder.
CONTROL:	One switch SPDT-Centeroff
INDICATORS:	One L.E.D. indicating the logic "O" condition
DATA RATE:	300 Baud (30 ASCII Char per sec.) 2400 Baud (240 ASCII Char per sec.)
ENCODING METHOD:	'Kansas City' Biphase Standard; Serial Asyncronous, using one or two stop bits, non-saturating, self clocking, syncronous frequency shift. The encoding method is also called the Biphase-M and Manchester code.
ERROR RATE:	Typically less than 1 in 10E6 bytes at 30 char/sec. using premium tape and high quality (Sony 103) recorder
CAPACITY:	C-60 100K Bytes/tape C-30 50K Bytes/tape
DATA TERMINAL:	Any RS232 or loop current device compatible with the 6800 system.
PHYSICAL SIZE:	SWTPC 6800 I/O card (3" x 5")
AUDIO LEVEL:	4 Ohm external speaker level at 100 mV
POWER:	+12, -12, 8V regulated on ACI-33

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P 8

Compleat Guide to Logic Diagrams

. . . the right and wrong way

Russell Lauffer
3291 Sepulveda, Apt. 4
Los Angeles CA 90034

We've had several articles in Kilobaud *dealing with proposed software standards and techniques for making life easier for the software types. The following article is directed toward the hardware people and establishes some conventions in logic diagram generation, which will make life a lot easier for those of us who have to interpret and use them. If you're going to be generating diagrams for a* Kilobaud *article (or any other magazine for that matter), I would strongly recommend following Russ's suggestions. – John.*

Logic diagrams should be easy to read. All too often we are confronted with diagrams that are ambiguous, difficult to interpret, lacking in detail and/or laid out without any thought for the person who has to use and analyze them. John Craig has been trying to ensure readable diagrams in the pages of *Kilobaud*, and it was his *KB* style sheet that prompted this article. The style sheet illustrates two examples of drawing a particular circuit; one right and one wrong. The message is simply that *the logic symbols should reflect the logic functions being performed.*

The All-NAND Approach

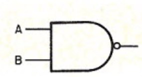
I mentioned logic diagrams that are "difficult to interpret." This is usually the case when a diagram contains *all* NAND gates or *all* NOR gates (although not so much of the latter, since NOR logic is not as commonplace as NAND nowadays). If a diagram contains all NAND gates, the person who drew the diagram is saying, in effect, that *all* of the logic functions being performed in that circuit are AND. There is no possible way this could be true with a circuit of any complexity.

I used to draw and interpret such diagrams myself. As a person is going through and interpreting an all-NAND diagram, he is constantly reminding himself of the two rules for the operation of a NAND: "Any low in will give a high out," and "both inputs high will give a low out." Most people who use these rules get along just fine – and even like them. They can even come up with good reasons why they should be used. Fig. 1 summarizes this "all-NAND" approach by showing the rules along with a truth table. The NAND is, of course, an AND gate and, therefore, the "active" function for a NAND is when it is performing an AND function. The "inactive" function is when the gate has a low going in, and the rule, "any low in will give a high out" applies. If you take a look at the truth table you will see that this condition is more likely to occur than the "active" AND function. After all, that covers three out of the four conditions that a two-input NAND gate can be in at any time! That's all right, but there is a better way.

The Better Way

Stop for a moment and consider that "inactive" NAND rule. "Any low in will give a high out." Isn't that word *any* really saying *OR*? Aren't we really saying that if input A *or* input B is low, then the output will be high? Of course we are, and, therefore, the gate should be drawn to reflect this OR function. Since we are dealing with an OR gate that is looking for low inputs, the gate should be drawn with the *state indicators,* or circles, at the input. Fig. 2 illustrates an example, both verbally and symbolically, of this situation. The negated-input OR unquestionably does a better

The NAND "activated function" may be stated as follows:
Only when both inputs are high will the output be low.
The NAND "inactive function" may be stated as follows:
Any low in will result in a high out.



INPUTS		OUTPUT	
A	B	X	
0	0	1	"INACTIVE"
0	1	1	"INACTIVE"
1	0	1	"INACTIVE"
1	1	0	"ACTIVATED"

INPUTS		OUTPUT
A	B	X
L	L	H
L	H	H
H	L	H
H	H	L

Note: With regard to the AND function (AND & NAND), the lows are considered the "dominating" signal since *any* low in will affect the output.

Fig. 1. Understanding the "all-NAND" approach.

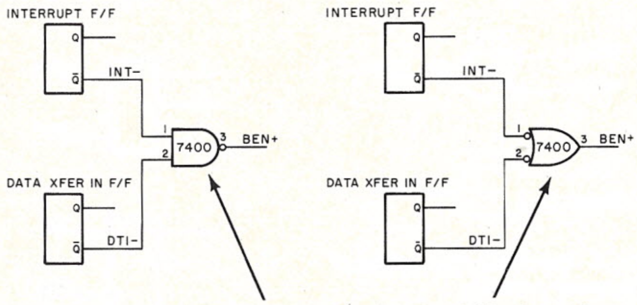
job of representing the logic function being performed. The circles are, in fact, state indicators. They are "indicating the state of the input and output signals when the logic function of the gate (AND or OR) has been satisfied." Fig. 3 illustrates this point even more clearly for a 7400 NAND and a 7400 NOR. (Notice that both truth tables are the same!)

You will notice I haven't mentioned anything about *inversion.* Too many people look at those circles as *just inverters.* Therein lies part of the problem. No doubt they represent inversion, but we need to look at them as state indicators also (indicating the state of the conditions to satisfy the logic function of the gate).

Before we leave this area and move on to more exciting things, we should take a look at one more example. This time let's look at a 7408 AND gate and its equivalent OR. Fig. 4 has a statement of the logic function being performed (with the key word) and you are given the opportunity to choose the most appropriate gate symbol. If you didn't pick the OR gate, then leave this article right now and go on to the next one!

Fig. 5 actually summarizes this section. Quite simply, for every AND (or NAND) function there is an equivalent OR (or NOR) function. If the

Statement of the logic function: "If an interrupt is in progress (INT- is low) or a data transfer into the processor is taking place (DTL- is low), the bus enable signal (BEN+) will be generated."



Question: Are the two low-active signals being ANDed together or ORed together?

Fig. 2. NAND/NOR example.

inputs of a NAND are negated then the equivalent OR will have the output negated. Nothing to this, right?

If I accomplish anything with this article, I hope I at least convince many people to stop the practice of using one kind of symbol in their diagrams *and labeling it as something else!* Fig. 6 has some examples of this, which I'm sure you have seen before. In other, even worse, instances, the gate's function is explained in the text rather than labeled on the diagram.

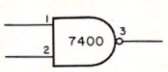
Signal Notation

In Fig. 4, you may have noticed a difference in the signal notation from what I had been using in other examples. I used a bar, or vinculum, over the signal mnemonic to indicate a "not" term. There have been a wide number of different notations used by various manufacturers; Fig. 7 lists some of them. The most important point to remember when generating a logic diagram is to adopt *one* convention, explain it to the reader if necessary and be sure to stick with it.

As far as interpretation is concerned, there are a couple of things to keep in mind when going through a *correctly drawn diagram.* If a negated, notted, complemented or low-true signal (whichever suits you) is going into a gate that has a state indicator at the input, the signal will do its part to satisfy the logic function of that gate. This is also the case for a high-true signal going into an input without a circle. We have two such conditions illustrated in Fig. 8. The first one is SYNC- in Fig. 8a, which is a low-true signal going into an "active-high" input, i.e., the gate expects high inputs to satisfy its NAND logic function. When you see a situation like this, it is simply a matter of doing a verbal inversion to make it clear what is happening. The statement next to the mnemonic has accomplished this ("High when sync F/F is *not* set"). Now, take a look at Fig. 8b, and you will see the same thing being done with the high-true PAR+ going into "active-low" input. The signal will be low when a parity error is *not* present — thereby satisfying the gate.

Polarity Mismatches — Avoid Them!

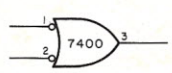
Now we get into the real meat of the matter — the elimination of *polarity mismatches* in logic diagrams. A polarity mismatch means that an active-high input (no circle or state indicator) is going into an active-low input (one with a circle) and vice versa. If the conventions we've discussed previously concerning gate symbols reflecting the logic function are followed, then this situation will be kept to a minimum. The result will be diagrams that are much easier to interpret and use. The example John Craig uses in the *Kilobaud* style sheet is good, in my opinion, so we will repro-



NAND TRUTH TABLE

INPUTS		OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

The "active" NAND function. The state indicator (circle) at the output of the gate indicates the active output is low, and the absence of circles at the inputs indicates they will be high when the NAND function is performed.

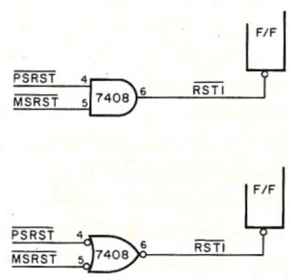


NOR TRUTH TABLE

INPUTS		OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

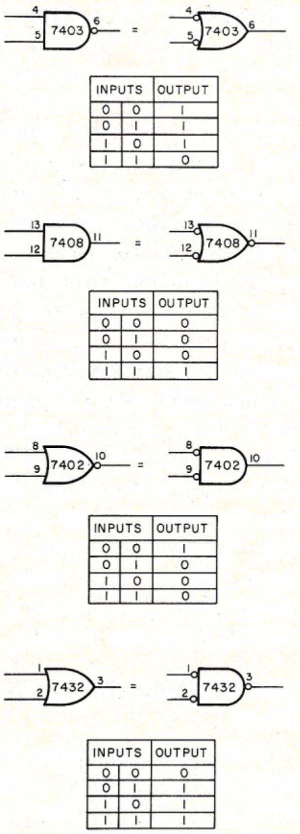
The "active" OR function. The state indicators at the input, and absence of one at the output, are indicating that any low input will be ORed through and become a high at the output.

Fig. 3. NAND/NOR truth tables and statement of functions.



Statement of logic function: If either Power-on System Reset ($\overline{\text{PSRST}}$) is true (low) or Manual System Reset ($\overline{\text{MSRST}}$) is true (low), then $\overline{\text{RST1}}$ will go low, resetting the flip-flop.

Fig. 4. Which circuit best reflects the logic function being performed?



INPUTS		OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

INPUTS		OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

INPUTS		OUTPUT
0	0	1
0	1	0
1	0	0
1	1	0

INPUTS		OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

Fig. 5. Equivalent gates for both AND and OR logic functions.

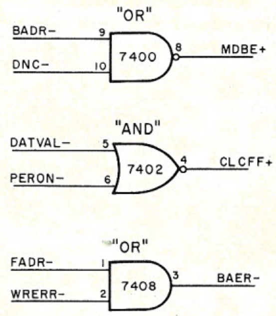


Fig. 6. Use of labeling instead of the proper symbol.

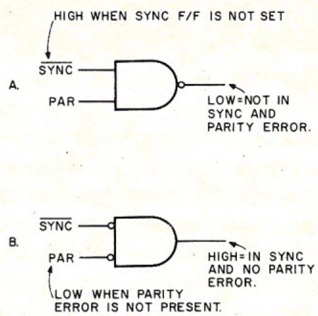
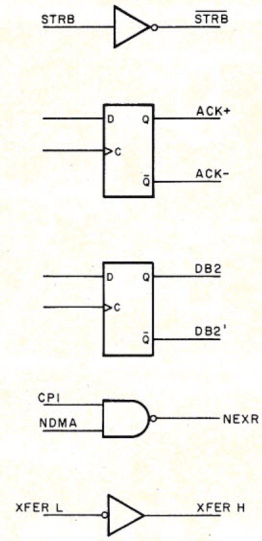


Fig. 8. Interpreting the function in spite of the signal notation.



Description

Using the bar (vinculum) to indicate the "not" function (or low-true signal).

Positive-true and low-true signals indicated by plus and minus signs, respectively.

Prime sign used to indicate the "not" signal.

Letter N used to indicate the low-true signal.

Letters H and L used to indicate high-true and low-true signals, respectively.

Fig. 7. Various forms of signal notation.

duce it in Fig. 9 and refer to it during the discussion that follows.

Fig. 9a illustrates an incorrectly drawn logic diagram. This is evident because of the mismatches present between the gates in the diagram. The mismatches aren't so much the *reason* for the incorrectness as they are a *clue* that something is amiss. Starting at the left, the first (and key) mismatch occurs when we see those single-pole switches to ground going into the NAND gates, IC1 and IC2. The purpose of this circuit is to detect a switch closure of *any* of the switches, and the low inputs certainly aren't going to do the trick for a NAND function. It becomes obvious that IC1 and IC2 are performing an OR function, and should be drawn accordingly. This has been done in Fig. 9b. The result is that the mismatch between IC1, IC2 and IC3 has been eliminated. IC3 should be left as is because it is definitely performing an OR (make that NOR) function. The only reason for changing the inverter's state indicator from the output to the input is to eliminate the remaining mismatches and indicate that an active high is coming out of the inverter – and is being "looked for" by IC5.

John Craig provided a great deal of the material for this article. He told me that he not only changes diagrams so they reflect the logic function, but he also examines them for mismatches as a means of checking for accuracy and errors. One of his scribbled notes (article material) related a good example of finding an error using this technique. Fig. 10 is a diagram based on John's example. His first clue that something was wrong came when he noticed the mismatch between IC1 and IC2. (Did you see it?) Now, if we examine the circuit and its function a little closer, we will see there is indeed a problem.

The purpose of the circuit is to service four request lines that have no particular priority but are individually enabled by the outputs of the mask register. When the request line and the mask bit are both high, the output of the corresponding gate of IC1 will drop low. *But* it seems that IC2 is looking for that signal *to be high* so that it can be ANDed together with the Enable signal to generate a low and set the request F/F. Also, in the static state, with none of the request lines active, the pin 1 input to IC2 will be pulled up to a high. If the Request Enable signal is also true (high) the flip-flop will remain set at all times. The mismatch was a flag that there was a problem with the circuit. As a result John was able to determine that an inverter definitely belonged between IC1 and IC2. Next time you generate a logic diagram, try using the same technique and see if it doesn't help. I should point out that there are instances when mismatches cannot be avoided. There will almost always be a mismatch when working with Exclusive OR gates and flip-flops.

Did Someone Say, "Flip-Flops?"

Here is an animal in a class all by itself – and the cause of a little confusion now and then. In two or three short licks we will either clear up years of confusion about flip-flops (we hope) or set everything back another ten.

The two most common flip-flops in use today are the D-type and the J/K. Fig. 11 contains diagrams of each and will serve as a guide during the following discussion of one of the areas of confusion: the circles.

Flip-flops have two kinds of circles – *active state indicators* on the direct Set (PReclear) and direct Reset (CLeaR) inputs, and *transition indicators* on the clock inputs. The presence of a circle at the direct Set and Reset inputs indicates that a low *level* will set or reset the flip-flop. (A logic 1, or high, being used for this purpose is unusual.) The wedge symbol at the clock input of both flip-flops denotes that they are clocked at the transition of the clock signal. In the case of the 7474 D-type, the wedge is by itself, i.e., *no circle*, which means it is clocked on the leading edge of the clock signal. On the other hand, the 7476 J/K *has a circle with the wedge*, meaning it is clocked on the trailing edge of the clock signal. It is all very clean cut, and the omission of the

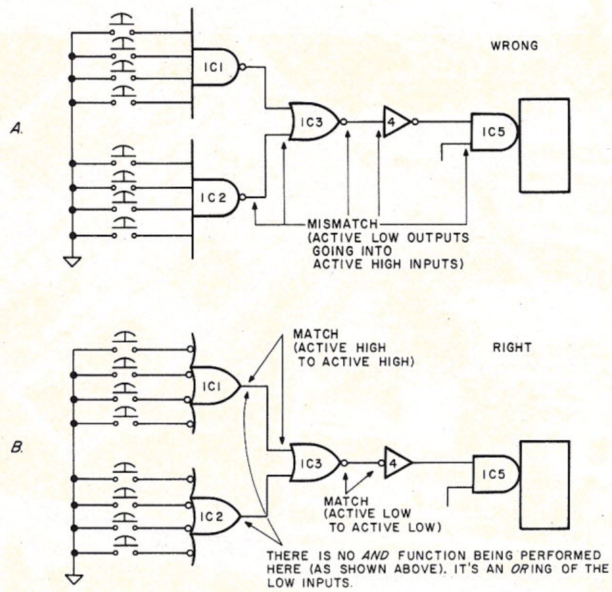


Fig. 9. Example from Kilobaud *style sheet.*

appropriate circles and wedges on flip-flops in logic diagrams simply makes those diagrams more difficult to interpret. Why not make them complete?

Over the years, I've developed a pet peeve about how some draftsmen and/or designers can manage to totally mess up a flip-flop symbol so you can hardly make out what it is! (It could be that frustration is the real reason for my writing this article.) Fig. 12 has a couple of beautiful examples I've run across recently, and they typify what we have all had to put up with for too long.

There is no reason why a person should have to go dig out a Data Book for a flip-flop, or other logic symbol, in order to interpret a diagram!

Both of those flip-flops should have been drawn the same as the 7474 in Fig. 11. They are so bad it is difficult to know where to begin in pointing out the "errors." (I put errors in quotes because this is all subjective.) To begin with, there should be a hard-and-fast rule concerning the *direction of signal flow.* It should always be from left to right (inputs on the left, outputs on the right). Both of the flip-flops in Fig. 12 show

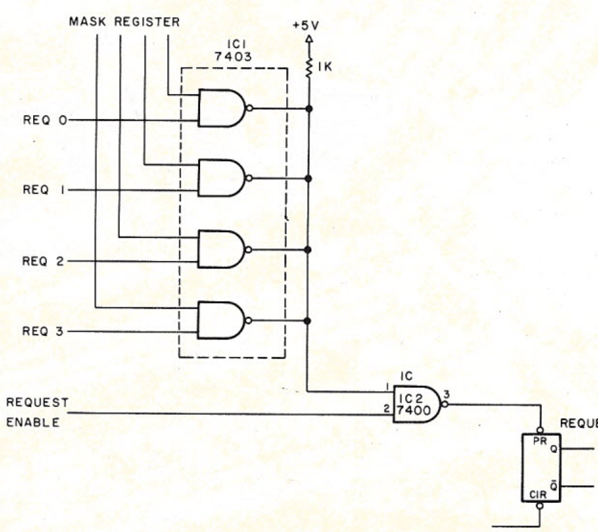


Fig. 10. Where is the missing inverter?

a backward right to left flow, which might be necessary ten percent of the time but usually can, and should, be avoided.

The person who drew Fig. 12a was at least decent enough to label the inputs and outputs inside the symbol. The person who generated the other one should have been considerate enough to do at least the same and not force the reader to go to a data book.

The most obscene thing that has been done to those two flip-flops is the way the inputs and outputs have been placed arbitrarily anywhere on the symbols — not to mention that the bottom one was laid on its side as though it were dying! Rather then dwell on the negative aspects of Fig. 12 we should refer back to Fig. 11 and discuss how a flip-flop *should* be drawn — and why.

Whether you are going to draw a flip-flop for an article in *Kilobaud* or on a napkin while having lunch with your 92-year-old grandmother, *please* put the Q output in the upper right-hand corner and the $\overline{Q}$ output in the lower right-hand corner! Put the Preset input on the top, the Clear input on the bottom and the Clock input at the left center (for D-type and J/K). The D input and the J input should always be in the upper left and the K input should be in the lower left. *Why* should we follow these conventions? Referring back to Fig. 11, note that by following the conventions just listed, all of the inputs that affect the Q output are at the top of the symbol (along with the Q output), and the inputs that affect the $\overline{Q}$ output are at the bottom of the symbol (with $\overline{Q}$). The input condition at the D or J input will be reflected at the Q output on the rising or trailing edge of the clock pulse. When Preset goes low, the Q output goes high. When Clear goes low, the $\overline{Q}$ goes high.

Use a Template! It Isn't any Harder

Fig. 13 illustrates a Rapidesign™ template for half-size standard logic symbols. These are the logic symbols for MIL-STD-806 and the American National Standards Institute (ANSI) Y32.14 standards. I asked John if he would have any objections to receiving a logic diagram drawn with the ANSI block-shaped symbols, such as in Fig. 14. He said, "Thanks, but no thanks." Fig. 14 illustrates how some of the symbols on the template are used for ANSI standard diagrams. Referring back to Fig. 13 I'm still not sure what the circle is for — I have never seen it in a logic diagram (except the old Univac bubble logic, and I know it wasn't for that). The

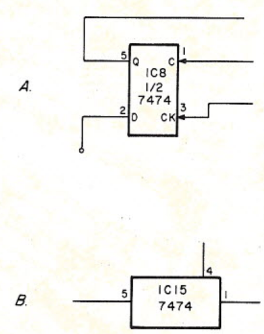


Fig. 12. Incorrectly drawn flip-flop symbols ("incorrectly" being an extremely mild term in this case).

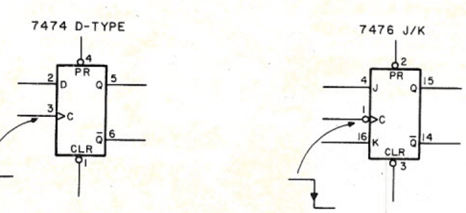


Fig. 11. Correctly drawn flip-flop symbols (inputs on the left and outputs on the right).

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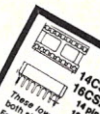

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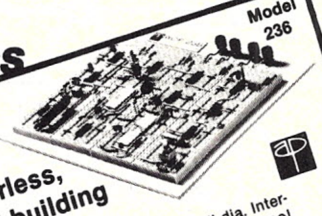
Model 236



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Gold-anodized aluminum base/ground; non-corrosive nickel-silver terminals; 4 rubber feet.

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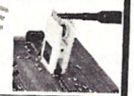

MODEL	Row-To-Row Dimension	PART NUMBER	PRICE
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TC-20	.3 IN.	923704	11.55
TC-22	.4 IN.	923705	11.55
TC-24	.5/.6 IN.	923714	13.85
TC-28	.5/.6 IN.	923718	15.25
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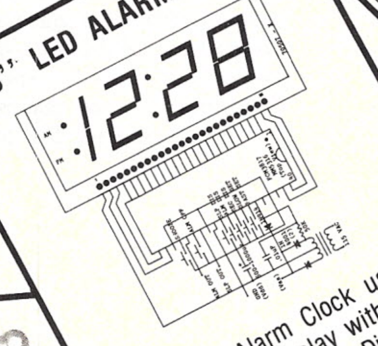

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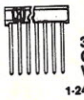

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8 pin	.47	.42	.37
10 pin	.45	.41	.37
14 pin	.39	.38	.37
16 pin	.43	.42	.40
18 pin	.75	.68	.62
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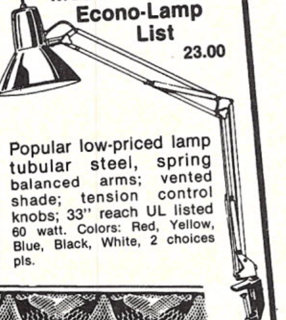

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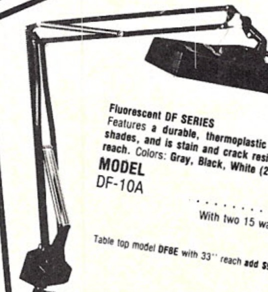

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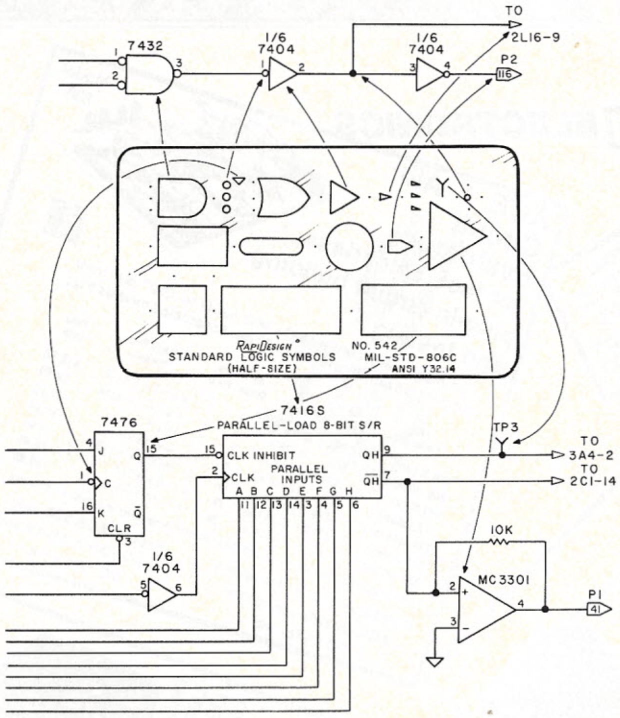

Fig. 13. Template = neat, easy-to-read diagrams.

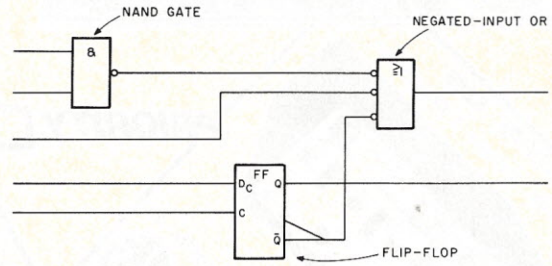

Fig. 14. Example of rectangular-shaped symbols of ANSI Y32.14. Easy to generate using a computer but hard to read using a person.

oblong symbol in the middle, to the left of the circle, was at one time used to represent a time delay, but I haven't seen it used in a logic diagram for many years.

There is every reason for you to go down to your local stationery store and buy a template such as this if you are going to be generating logic diagrams. After all, you should want them to be as neat and well laid out as possible.

Direction of Signal Flow and Diagram Layout

I have seen logic diagrams that were laid out so poorly that it was next to impossible to follow the signal flow. If it were a real necessity that I learn that particular circuit, I would usually redraw it. Fig. 15 illustrates just such a circuit. This is a portion of a diagram of a popular 8008-based microcomputer that appeared several years ago in one of the popular radio/electronics magazines. I decided to build a wire-wrap version of this computer. Therefore, it was necessary for me to redraw the sche-

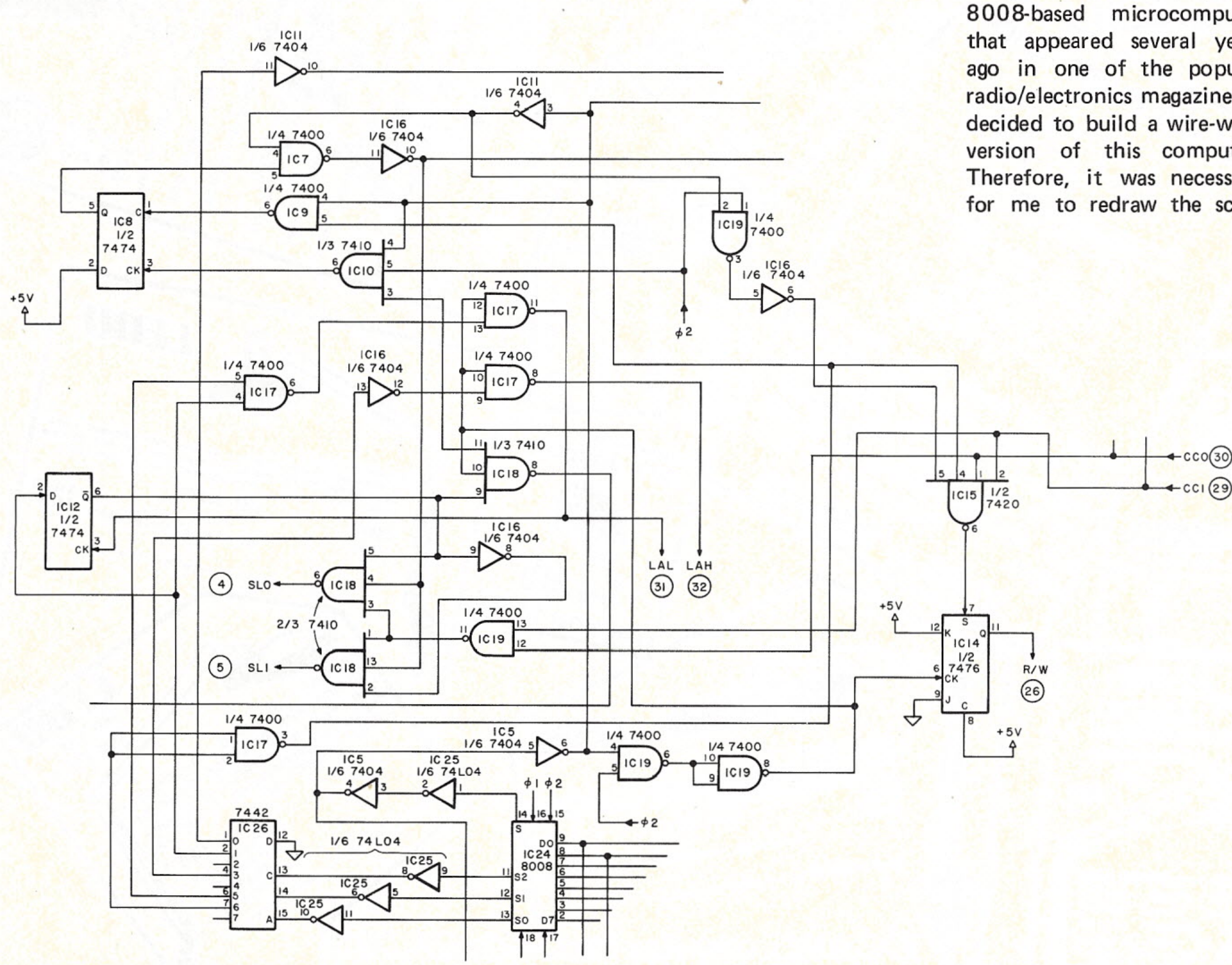

Fig. 15. An example of a logic diagram that should have resulted in the engineer and/or the draftsman's being taken out and shot at sunrise!

matic (since each IC would have a different designation on my layout than it did in the original drawing). Plus, I felt that by redrawing the circuit I would come to a better understanding of how it worked. How right I was. I would recommend redrawing logic diagrams whenever you feel you need to gain a better understanding of how they work.

Fig. 16 is the new version of Fig. 15. Perhaps the most significant change, and improvement, is that the signal flow is from left to right.The flip-flops have all been drawn in a standard format, the logic gates reflect the logic function being performed and there are notations above various circuits to indicate their functions (e.g., "Interrupt Acknowledge F/F").

Notice that "polarity mismatches" between the gates are kept to a minimum, and even when they do show up they aid in interpretation. For example, IC19 (in the upper left-hand corner) has, as an input, the output of IC5. IC5 has a circle as the output, and IC19 does not on the corresponding input. The circuit is simply saying the $\overline{\text{SYNC}}$ is being ANDed with Ø2. (In some cases the pin numbers may not match up perfectly since I made some layout changes for my wire-wrap version.)

The most important point about this entire exercise is that the signal flow in a logic diagram should always, whenever possible, be *from left to right.*

Block Diagrams

Block diagrams are important tools in interpreting logic diagrams. They provide us with the "big picture" of the circuit and should always be included with a diagram of any complexity.

Two considerations should be kept in mind when generating a block diagram of a circuit. First, the flow should be from left to right (the same as the logic diagram). Second, the block should not contain detailed information that you would find in the logic diagram. For example, if four quad-D-type flip-flops are used to make up a 16-bit register, the block diagram should illustrate this with a single block labeled "16-bit Register."

Conclusion

I said it in the beginning, and I'll say it again: Logic diagrams should be easy to read. Using the correct gate symbol to reflect the logic function being performed, having the signal flow go from left to right, adding comments to the symbols, identifying their functions and using a template are just some of the ways to accomplish this.

A well-drawn logic diagram is just as important for the hardware person in aiding him to interpret the diagram as a well-documented program is for the software person. One of the references for this article is the TI *Data Book for Design Engineers.* That data book (and others)

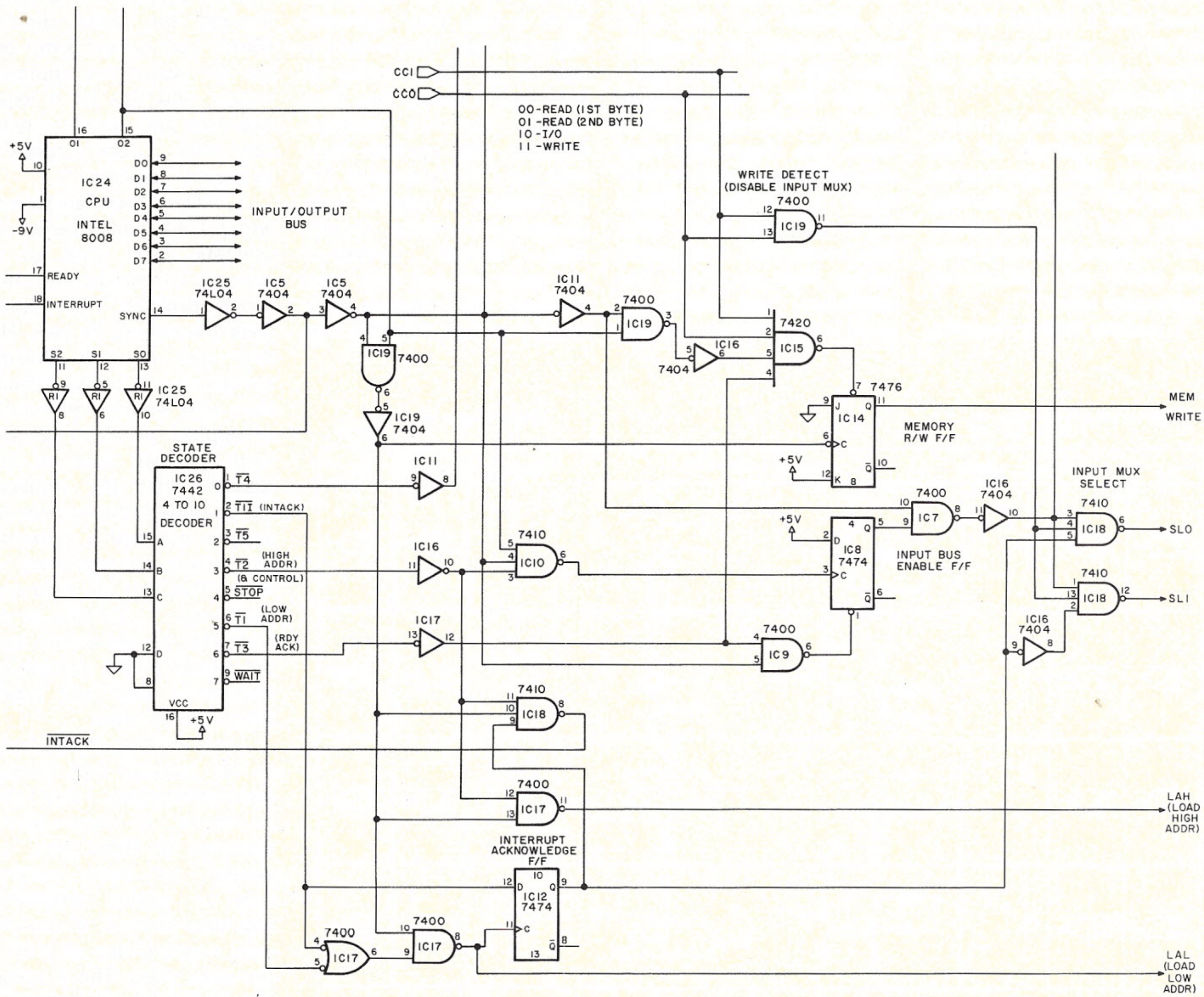

Fig. 16. Another look at Fig. 15.

should be used *when you are generating logic diagrams.* It should *never* be necessary for the user of that diagram to refer to a data book for information — it all should be in the diagram. ■

References

1. MIL-STD-806B, USAF, 1962, Graphic Symbols for Logic Diagrams.
2. ANSI Standard Y32.14-1973, Graphic Symbols for Logic Diagrams.
3. *The TTL Data Book for Design Engineers,* Texas Instruments, 1973.
4. P. M. Kintner, "Mixed Logic; A Tool for Design Simplification," *Computer Design,* August 1971, pp. 55-60.
5. John F. Wakerly, "Documentation Standards Clarify Design," *Computer Design*, February 1977, pp. 75-85.
6. Peter A. Stark, "Is it High? — or Low? . . . understanding logic design conventions," *Kilobaud*, May 1977, pp. 56-58.

Positive or Negative Logic

This business of logic diagram conventions can get to be somewhat of an emotional issue with some of the hardware types within our ranks, and I'm one of those with strong feelings. I used to teach courses in computer hardware and troubleshooting, and I found it was ten times easier to explain and analyze a circuit if the diagram symbols reflected the logic function being performed (that's beginning to sound like a broken record, isn't it?) . . . rather than being drawn with all NAND or all NOR gates.

In his article, Russ points out one example of the reasoning that accompanies "all-NAND" logic diagrams. There are a couple of others, and I'm going to discuss them here briefly (or, I should say, "take them apart!?").

I recently had a conversation (heated discussion) with one of the most renowned authors in the computer hobbyist field. He is adamant in his opposition to using equivalent gates in diagrams. He refers to them as negative logic . . . but more on that later. His argument was that the gate should reflect the hardware . . . and since a 7400 IC, for example, is shown in all data books as a NAND gate, *"that's what it should always be drawn as."* He pointed out that it is never depicted as a negated-input OR. He's right, and I suspect that if the manufacturers put both gates in all of those data sheets (for negative and positive logic conventions — total of four symbols) we'd have some really thick data books. But, that's really neither here nor there. The interesting, and significant, point is that the internal logic diagrams accompanying the medium-scale IC spec sheets in those same data books are drawn using the conventions described in the article. I found this to be true with the three data books I checked (TI, Signetics and National). I'm not at all convinced that the reason given (the symbol should reflect the hardware, i.e., the diagram in the data book) is a valid one.

Another "argument" against the use of equivalent gates is that they represent *negative logic.* That is not the case at all. (As a matter of fact, you'll notice that Russ Lauffer did not mention negative and positive logic *even once* in his article.) I'm as oppossed to negative logic as anyone could be. We still have it, though . . . many of the buses we deal with were designed with negative logic levels. I'm just thankful that positive logic conventions are dominant within the industry today. Fig. A is a diagram I generated about five years ago for a book I was going to write on digital logic (never quite made it). The chart illustrates equivalent AND and OR gates for positive logic and equivalent AND and OR gates for negative logic. I generated the diode and resistor-transistor logic circuits, just so a person could take the two different conventions through the same circuit. (Don't you purists jump on me for specifying approximately plus five for a logic one volts and approximately zero volts . . . the purpose is to keep things simple.)

I invited that well-known writer I mentioned earlier to generate some kind of a response concerning this issue and he declined. I can appreciate the reasons he gave. He said that he had already written several books (which have sold tens of thousands of copies) in which he put forth his own ideas on the subject (that the symbols should reflect the hardware), and to generate a response would only add legitimacy to mine. That left me with one alternative . . . I'd have to go read what he had written and put myself in the position of responding (and add legitimacy?) to his ideas.

Upon reading the sections in his book(s) that discuss logic conventions, I feel I can generate a very good response. He states that, "In general, for every positive way of stating something logically, there is an equally valid negative way of stating the same thing. This is called the *DeMorgan equivalence."* What this means is that a

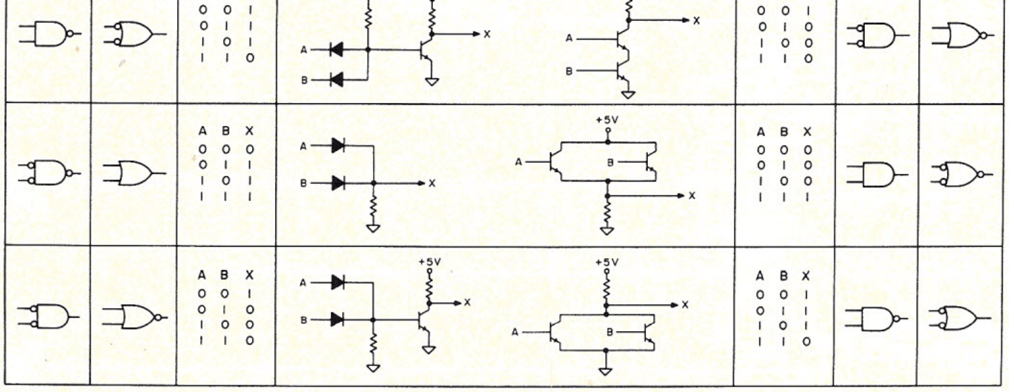

Fig. A. Diagram illustrating equivalent AND and OR gates for positive and negative logic.

positive-logic NAND gate is exactly the same *circuit* as a negative-logic NOR gate. Part of that statement is absolutely correct, and part of it is absolutely incorrect . . . and is probably the reason he, and a lot of other people, go around referring to equivalent gates as negative logic. (He doesn't really take the use of equivalent symbols to task in his book, but he sure did in our conversation!)

Applying DeMorgan's Theorem to come up with an equivalent logic function *does not change the logic convention* (i.e., from positive to negative and vice versa). Augustus DeMorgan and George Boole (Boolean Algebra) were two famous logicians and mathematicians in England in the early 1800s. Boole developed a method of expressing logical arguments symbolically, and his friend DeMorgan developed a theorem that stated: "The negation of the disjunction (or conjunction) of two statements is logically equivalent to the conjunction (or disjunction) of the negations of the two statements." You can bet your sweet assembler that Augustus came up with that theorem long before positive and negative logic conventions came along! Fig. B is an example of applying DeMorgan's theorem.

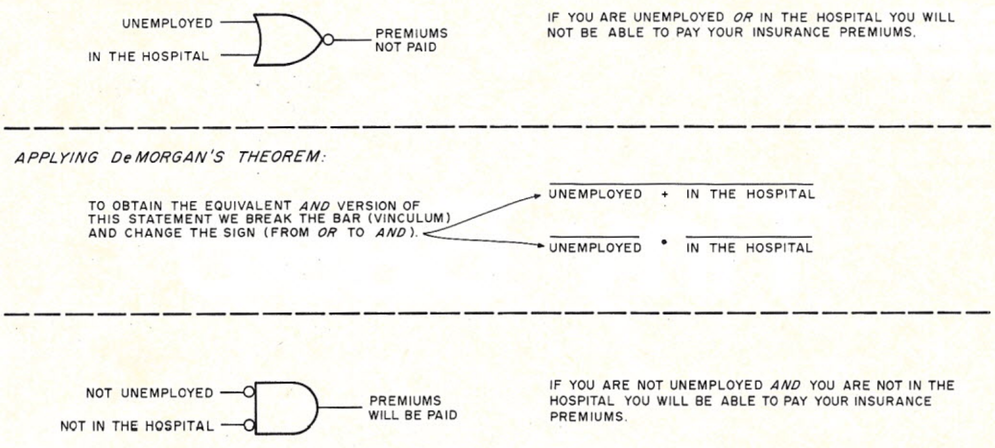

Fig. B. An application of DeMorgan's theorem.

The example in Fig. B is neat and interesting (and certainly demonstrates how DeMorgan's equivalency theorem works), but what we're really interested in are the equivalent gates under the positive logic column in Fig. A and the equivalent gates under the negative logic column. Running through the examples will, I hope, demonstrate to even the most skeptical that there is a sharp distinction between equivalent gates . . . and positive and negative logic.

Let's start using equivalent gates to illustrate more clearly just what is going in our logic diagrams, and let's drop this negative logic business — or even the idea that equivalent gates represent negative thinking, because they don't. ■

John Craig

Ron Anderson
3540 Sturbridge Ct.
Ann Arbor MI 48105

Tiny Basic

Issue #1 of *Kilobaud* contained an article by Tom Pittman describing his Tiny BASIC. As a very optimistic owner of a new KIM-1, and with a SWTP CT-1024 TV terminal on order, I sent my order off to Tom's Itty Bitty Computer Company, and soon my Tiny BASIC listing arrived. Lacking the terminal, I spent a Saturday loading Tiny by hand with the hex keyboard and verifying it. When the last kit of the TV terminal arrived, I loaded Tiny. A close reading of the instructions indicated that I had to insert some I/O jump addresses. This done, Tiny ran with nothing more than operator problems.

It was not hard to begin programming some of the simpler games from *Basic Computer Games* published by Digital Equipment Corp.

As limited as it is, using only 2½K of memory (I had added an Econoram 4K expansion to my KIM), a great deal can be done with it that is not obvious on first glance.

At the bargain price of $5 I didn't expect a full course in BASIC programming. But there are some features that are not obvious and could be expanded upon for those of us who are rank beginners.

First, here are a couple of ways to save memory:

1. PRINT may be abbreviated PR in all cases. For example:

```
50 PR"HI THERE!"
```

2. Tiny needs no spaces in the program statements. A listing is hard to read without them, but it is better than running out of memory.

3. Tiny has no absolute value function. This can be implemented easily as follows:

```
100 IF A<0 A=-A
```

4. Tiny has no ON N GOTO statement (see Example 1).

```
150 ON N GOTO (100,110,120,130)
```

Example 1.

The following allows the same results:

```
60 GOTO 100+10*N
```

This is particularly useful in implementing a game like Bombers (see *Basic Computer Games*). Here the player is given a multiple choice, and the number he enters (N) determines a branch in the program.

My TV typewriter is the kind that "pages"; when the screen fills, it "flips" a page and starts to fill it from the top. If output such as instructions extends to more than one full page, it is lost before it can be read. This would also be a problem with a scrolling display, particularly if the TVT is running at 1200 baud. The program can contain a "pause for read" which can be implemented easily at the desired point.

```
100 T=0
105 T=T+1
110 IF T<150 GOTO 105
```

The T less-than number may be adjusted for a suitable time delay. These steps may be a subroutine, and T may be randomized by Example 2.

```
110 IF T<(RND(150)+10) GOTO 105
115 RETURN
```

Example 2.

The delay loop is used to add interest to a game, where the computer outputs "LET ME THINK A MOMENT . . ." and that is what seems to be happening.

I've made my Hunt the Hurkle game a little more interesting for a first-time player by including a random 1 out of 15 chance of seeming confusion on the part of the computer. The result is that instead of the normal THE HURKLE IS HIDING message, the printout is as shown in Example 3.

```
THE HURDLE IS HIKING       (pause random time)
NO, THAT'S NOT RIGHT       (pause random time)
THE HIDEL IS HURKING.      (pause random time)
NOW WAIT A MINUTE!         (pause random time)
THE HURKLE IS HIDING.
```

Example 3.

Here the program resumes its regular course.

Last but not least, Tiny BASIC lacks any kind of string manipulation. It is possible to get around this by using Y and N for Yes and No responses as shown in Example 4.

```
50 PR"WANT TO PLAY AGAIN";
60 Y=1
70 N=0
80 INPUT R
85 REMARK R FOR RESPONSE
90 IF R=1 GOTO 10
100 PR"THANKS FOR PLAYING. HOPE YOU ENJOYED IT"
999 END
```

Example 4.

A little ingenuity allows many tricks in Tiny BASIC. Use a little imagination, and it can be great fun.

I started out in this hobby with full intentions never to waste time playing games with my computer. Obviously I've changed my mind. The reason is that programming games seems to be a very good way to learn all the tricks and non-tricks of programming in BASIC. I still intend to do a lot of machine language programming, but I can't imagine a way to learn BASIC faster than by using it to program a game. Thanks, Tom Pittman, for Tiny BASIC. It really works. ■

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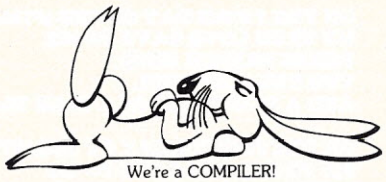

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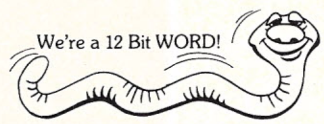

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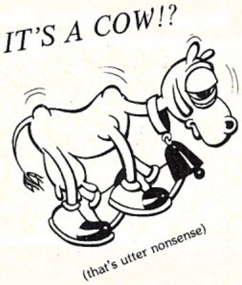

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COMPILE	RENAME	COS	TAN	DATA	(LET)	PRINT USING
DELETE	REPLACE	EXP	POS	DIM	NEXT	RANDOMIZE
EDIT	RESEQUENCE	INT	TAB	END	ON..GOTO	READ
EXECUTE	RUN	LOG	ASCII	FOR	ON..GOSUB	REM
LENGTH	SAVE	PI	CHR $	GOSUB	ON EOF GOTO	RESTORE
LIST	SCRATCH	RND	LEN	GOTO	OPEN file for input	RETURN
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The Twelve Days of Christmas

```
ON THE FIRST DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
A PARTRIDGE IN A PEAR TREE.

ON THE SECOND DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE THIRD DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE FOURTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE FIFTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE SIXTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.
```

Sample run. (Note: There are

I wrote the following program as a demonstration of the BASIC FOR/NEXT loop. I thought it would make an interesting contribution to the *Kilobaud* holiday issue. Merry Christmas! ■

```
10 DIM A$(12),B$(12)
15 PRINT:PRINT:PRINT
20 FOR I=1 TO 12
30 READ A$(I)
40 NEXT I
50 FOR I=1 TO 12
60 READ B$(I)
70 NEXT I
80 C$=""
90 FOR I=1 TO 12
100 PRINT"ON THE ";B$(I);" DAY OF CHRISTMAS"
110 PRINT"MY TRUE LOVE GAVE TO ME"
120 FOR J=I TO 1 STEP -1
130 IF J<>1 THEN 170
140 PRINT C$;A$(J)
150 C$="AND "
160 GOTO 180
170 PRINT A$(J)
180 NEXT J
190 PRINT
200 NEXT I
210 PRINT"*********************************"
220 END
230 DATA "A PARTRIDGE IN A PEAR TREE.","TWO TURTLEDOVES,"
240 DATA "THREE FRENCH HENS,","FOUR COLLY BIRDS,"
250 DATA "FIVE GOLD RINGS,","SIX GEESE A-LAYING,"
260 DATA "SEVEN SWANS A-SWIMMING,","EIGHT MAIDS A-MILKING,"
270 DATA "NINE DRUMMERS DRUMMING,","TEN PIPERS PIPING,"
280 DATA "ELEVEN LADIES DANCING,","TWELVE LORDS A-LEAPING,"
290 DATA FIRST,SECOND,THIRD,FOURTH,FIFTH,SIXTH
300 DATA SEVENTH,EIGHTH,NINTH,TENTH,ELEVENTH,TWELFTH
```

Program listing.

ON THE SEVENTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
SEVEN SWANS A-SWIMMING,
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE EIGHTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
EIGHT MAIDS A-MILKING,
SEVEN SWANS A-SWIMMING,
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

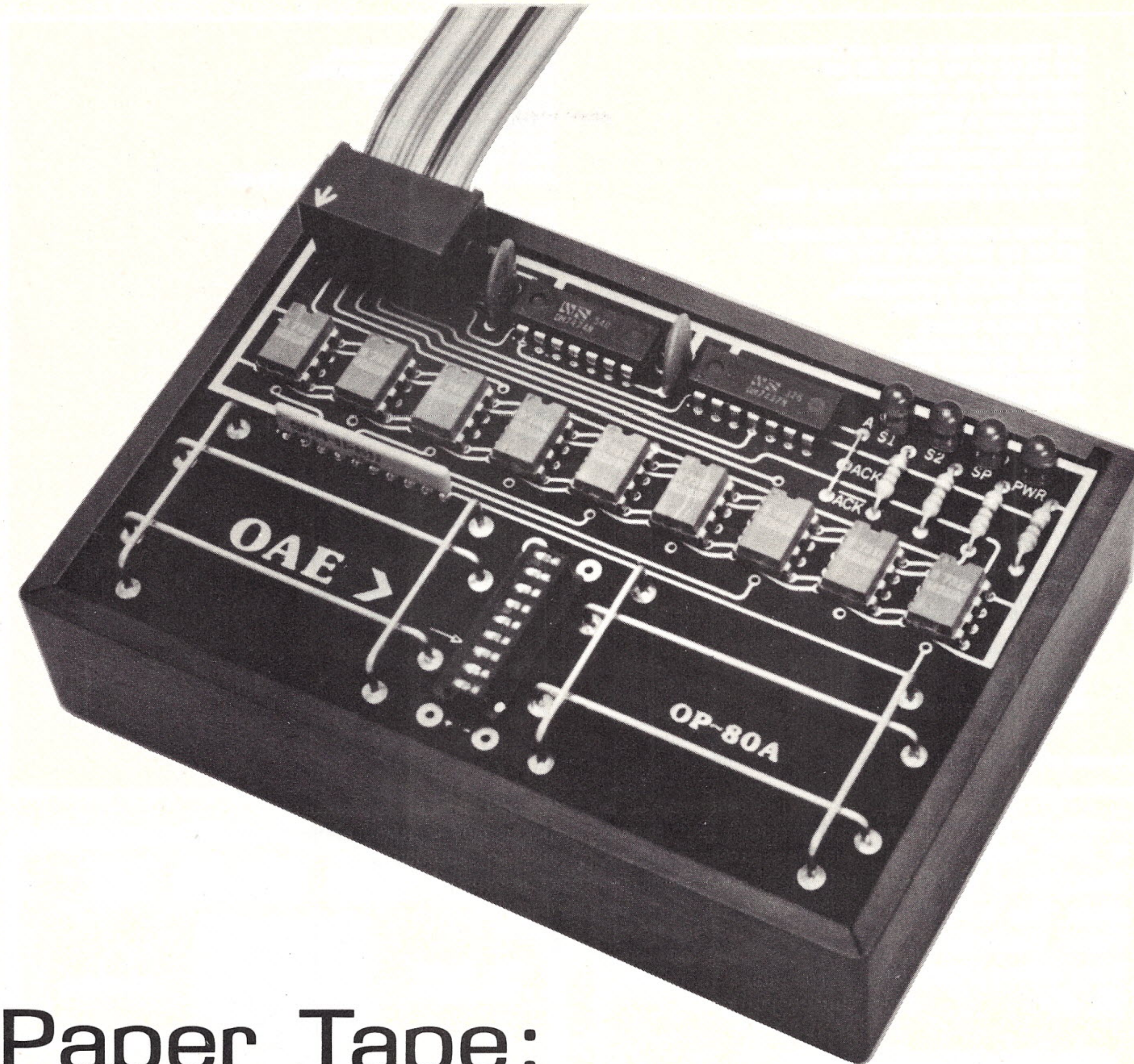
ON THE NINTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
NINE DRUMMERS DRUMMING,
EIGHT MAIDS A-MILKING,
SEVEN SWANS A-SWIMMING,
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE TENTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
TEN PIPERS PIPING,
NINE DRUMMERS DRUMMING,
EIGHT MAIDS A-MILKING,
SEVEN SWANS A-SWIMMING,
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE ELEVENTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
ELEVEN LADIES DANCING,
TEN PIPERS PIPING,
NINE DRUMMERS DRUMMING,
EIGHT MAIDS A-MILKING,
SEVEN SWANS A-SWIMMING,
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

ON THE TWELFTH DAY OF CHRISTMAS
MY TRUE LOVE GAVE TO ME
TWELVE LORDS A-LEAPING,
ELEVEN LADIES DANCING,
TEN PIPERS PIPING,
NINE DRUMMERS DRUMMING,
EIGHT MAIDS A-MILKING,
SEVEN SWANS A-SWIMMING,
SIX GEESE A-LAYING,
FIVE GOLD RINGS,
FOUR COLLY BIRDS,
THREE FRENCH HENS,
TWO TURTLEDOVES,
AND A PARTRIDGE IN A PEAR TREE.

two versions of the fourth verse: "colly birds" — as used here — or "calling birds." Take your pick.)



Paper Tape:

It's Here to stay

. . . a look at the OP-80A

Gordon W. Flemming
13490 Simshaw Avenue
Sylmar CA 91342

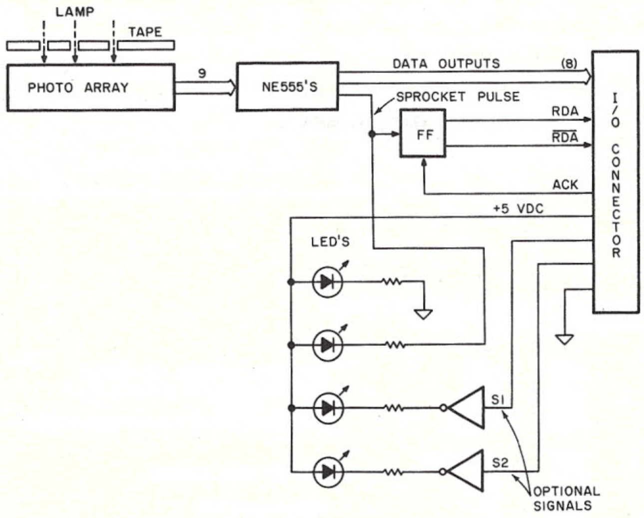


Fig. 1. OP-80A block diagram.

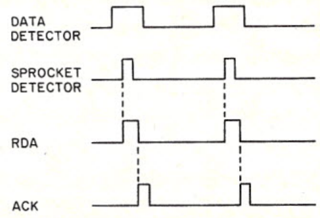


Fig. 2. Timing Diagram.

Are you tired of taking over ten minutes to load 8K BASIC and over six minutes to load a 4K assembler on your Teletype? Or, perhaps you don't have a Teletype, but you want to load punched tape programs? If so, then the Oliver Audio Engineering OP-80A paper tape reader will prove very useful.

If you don't mind the time it takes to load tapes at 10 cps, how about the noise? Again, the OP-80A will help solve the problem.

Using the OP-80A, I am now loading BASIC on one of my assemblers in about ten seconds, and very quietly too.

In addition to the assembled OP-80A, you will need a tape rewinder and a light source. I am using a high intensity desk lamp. I also built a small frame out of plywood and a piece of dowel to act as a tape supply reel.

The electronics of the OP-80A is very simple and Fig. 1 illustrates a block diagram of same. A precision phototransistor array is used to detect the light going through the tape holes. The outputs of the phototransistors are fed to NE555s which are used as level detectors. Except for the output from the sprocket hole detector, the NE555 outputs are wired to an integrated circuit socket used as an I/O connector.

The output from the sprocket hole detector is used to clock a flip-flop true. Since the sprocket hole is smaller than the data holes, the sprocket detector output will always be shorter in time and will be centered within the time that the data detector outputs are true.

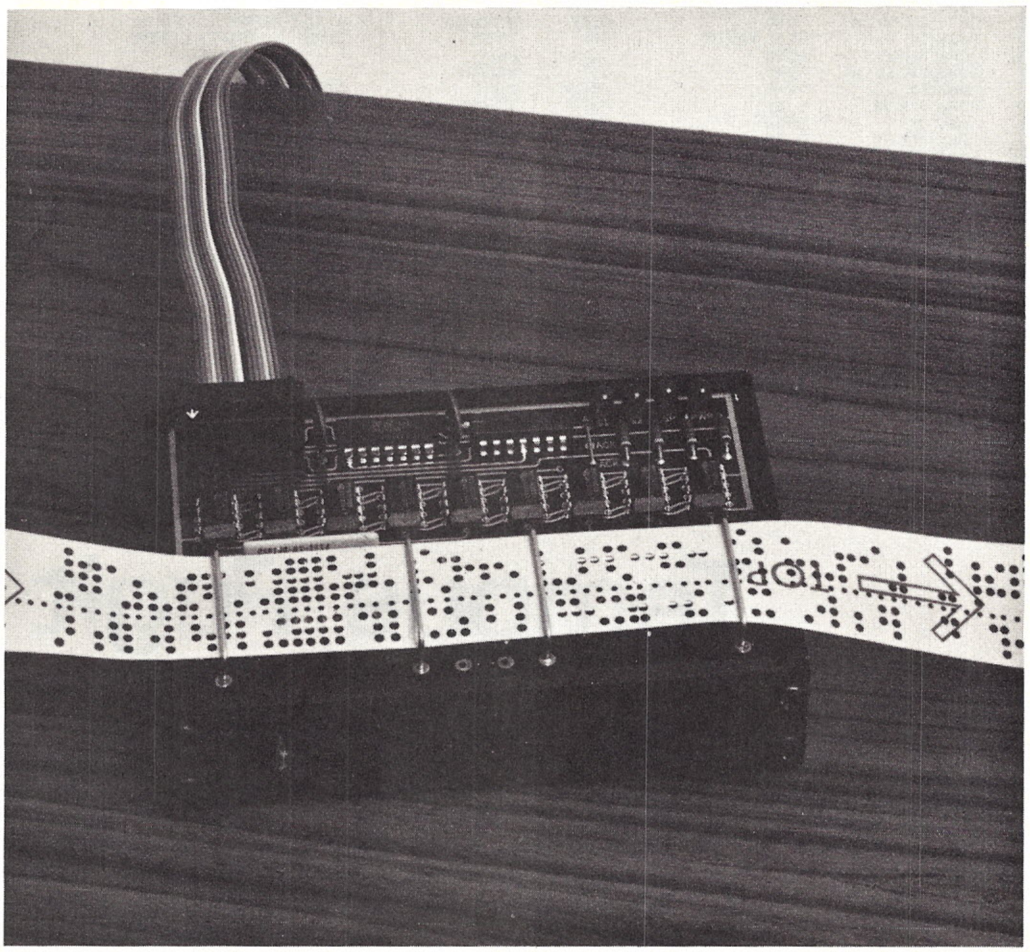
The output of the flip-flop is wired to the I/O socket as Reader Data Available (RDA). The flip-flop is cleared with the Reader Acknowledge (ACK) signal from the processor (via the I/O socket). Jumper wiring on the OP-80A provides for either polarity of ACK.

The timing diagram shown in Fig. 2 shows the relative timing of the signals. The delay from RDA to ACK depends on the software used and the microprocessor clock rate. Using the software shown in Program A on my Imsai 8080, I have found that I cannot pull the tape through the reader fast enough to lose data.

Four LEDs are included on the OP-80A. One of these is on when power is being supplied through the I/O socket. One is driven by the sprocket detector. The other two LEDs are connected through drivers to the I/O socket and may be used to display the status of any signal that you might want to monitor. A TTL high level will turn these LEDs on.

The only adjustment required is to adjust the height of the lamp above the OP-80A. This is particularly important when using semi-opaque tape rather than the black tape. The adjustment consists of lining up a sprocket hole over the phototransistor array and then lowering the lamp until the sprocket hole LED turns off.

Interfacing is accom-



plished by connecting the eight data outputs to a parallel input port. The RDA signal is monitored and an input of the parallel port is initiated when RDA goes high. After processing the data, an ACK is sent to the OP-80A to reset RDA.

For my installation, I used an IMS four channel parallel I/O board. As shown in Program A, I used input port 81H for data in. I wired RDA to input port 80H, bit 0. I wired output port 80H, bit 0, to ACK. ACK must be sent out twice. First as a 1 to clear the RDA signal and second as a 0 to allow the RDA flip-flop to be reclocked.

An alternate approach would be to use hardware to generate an ACK based on receiving the RDA signal. I elected to use the parallel I/O channel since it was available.

The OP-80A Owner's Manual includes instructions for using the OP-80A with a serial I/O board by connecting the OP-80A outputs directly to a type 2502 UART. This UART was used on the original MITS 88-SIO board. Using this method, no changes would have to be made to the serial I/O software.

The two programs show the method that I used to interface with my I/O structure. They will serve as examples of the type of data transfers that are required. After loading the IMS Assembler and BASIC once from the original tapes, I then punched binary tapes and have not used the tapes that were supplied since.

A word of caution . . . don't try to use the OP-80A to load BASIC program tapes. BASIC requires the carriage return time to process the line of data. The tape will soon get ahead of the input processing and data will be lost.

In conclusion, I have found the OP-80A to be a very worthwhile addition to my home computer system. It is reasonably priced and is available at most hobby computer outlets. ■

```
3000              *
3000              *THIS PROGRAM TO READ BINARY DATA
3000              *FROM PUNCHED TAPE ON THE
3000              *OP-80A
3000              *
3000              ACK     EQU   80H        ACKNOWLEDGE TO OP-80
3000              RDA     EQU   80H        READER DATA AVAILABLE
3000              TAPE    EQU   81H        DATA PORT
3000              START   EQU   0000H      LOCATION TO PUT FIRST BYTE
3000              *
3000 21 00 00     ST1     LXI   H,START
3003 3E 01        ST2     MVI   A,1        RESET THE OP-80A
3005 D3 80                OUT   ACK
3007 AF                   XRA   A          ZERO ACCUM
3008 D3 80                OUT   ACK
300A DB 80        TLOOP   IN    RDA        LOOP UNTIL RDA GOES HIGH
300C E6 01                ANI   1
300E CA 0A 30             JZ    TLOOP
3011 DB 81                IN    TAPE
3013 B7                   ORA   A          SET FLAGS
3014 C2 2A 30             JNZ   TLP2
3017 C3 03 30             JMP   ST2        LOOP BACK IF IN LEADER
301A 3E 01        ST3     MVI   A,1        START POINT AFTER LEADER
301C D3 80                OUT   ACK
301E AF                   XRA   A
301F D3 80                OUT   ACK
3021 DB 80        TLP3    IN    RDA
3023 E6 01                ANI   1
3025 CA 21 30             JZ    TLP3
3028 DB 81                IN    TAPE
302A 77           TLP2    MOV   M,A
302B 23                   INX   H
302C C3 1A 30             JMP   ST3
302F              *END OF TAPE READ PROGRAM
302F              *
302F              *THIS PROGRAM WILL PUNCH A BINARY TAPE
302F              *ENTER FIRST BYTE ADR IN 3030 AND 3031
302F              *ENTER H OF LAST BYTE ADR IN 303E
302F              *ENTER L OF LAST BYTE ADR IN 3044
302F              *
302F              TTYS    EQU   3          TTY STATUS PORT
302F              TTYD    EQU   2          TTY DATA PORT
302F              RDY     EQU   1          TRANSMIT READY
302F 21 00 30             LXI   H,3000H    FIRST BYTE H AND L
3032 DB 03        BEGIN   IN    TTYS       LOOP UNTIL TTY RDY
3034 E6 01                ANI   RDY
3036 CA 32 30             JZ    BEGIN
3039 7E                   MOV   A,M        MOVE BYTE TO ACCUM
303A D3 02                OUT   TTYD       PUNCH BYTE
303C 7C                   MOV   A,H
303D FE 30                CPI   30H        H OF LAST BYTE
303F C2 48 30             JNZ   CNT        IF NOT ZERO CONTINUE
3042 7D                   MOV   A,L
3043 FE 4E                CPI   4EH        L OF LAST BYTE
3045 CA 4C 30             JZ    STOP
3048 23           CNT     INX   H          MOV MEMORY ADR
3049 C3 32 30             JMP   BEGIN      GO BACK
304C C3 4C 30     STOP    JMP   STOP       WAIT HERE WHEN DONE
304F              *END OF PUNCH PROGRAM
304F              *
```

Program A. 8080 Assembly-language program for reading binary data with OP-80A.

Tempus Fugit

Steve Johnson
4615 W. Hayward Ave.
Glendale AZ 85301

We all have a pretty good concept of the duration of a second of time. When we deal with computer logic, we often talk in time intervals in the millisecond, the microsecond, the nanosecond and even the picosecond range. Most of us realize the actual values of each of these time measurements but how many of us actually have a feel for just how long each one of them is? Using the familiar second as a base, consider the following ratios:

1 millisecond per second = 1 second per 17 minutes.

1 microsecond per second = 1 second per 12 days.

1 nanosecond per second = 1 second per 31 years.

1 picosecond per second = 1 second per 38 centuries.

The next time you want to impress someone with the speeds at which computer logic works, don't confuse him with esoteric words, just show him this article. ■

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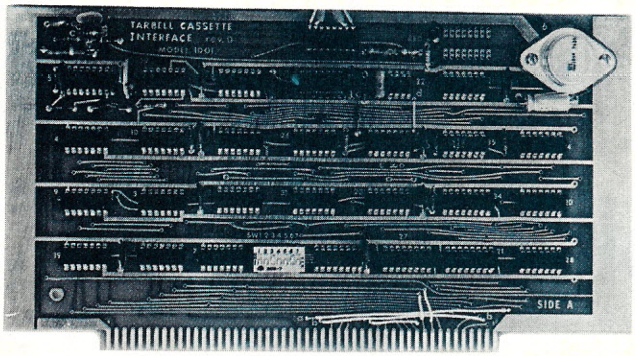

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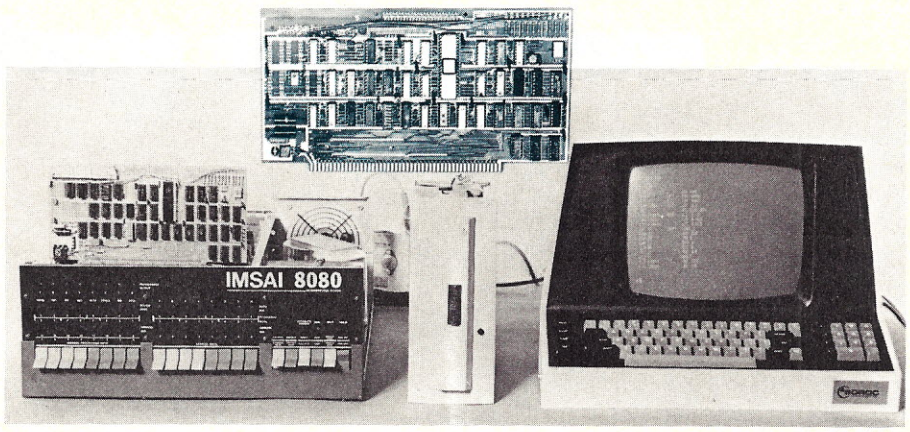

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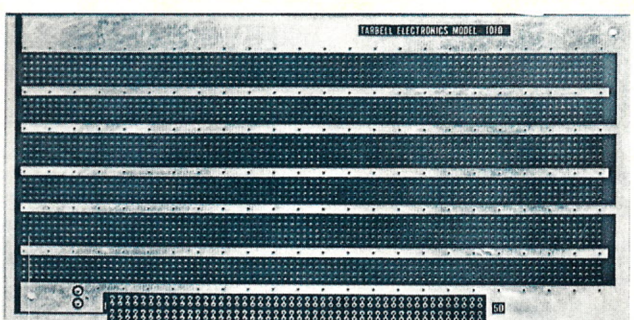

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Who Needs a Broker?

... analyze your stocks at home

Last May 8th George Haller celebrated his 70th birthday! He retired from General Electric as a vice-president ten years ago and I have no idea how he kept himself occupied for those first seven-and-a-half years of retirement ... but I can tell you what he's been doing for the last two-and-a-half! He's been having a ball with his home computers ... and generating neat software (like the following) to share with the rest of us. It really makes you a little green with envy when you hear about someone in retirement who has computers as a hobby*! – John.*

Your computer is a very handy device in which to keep your security records. In addition to using it as a file, you can retrieve pertinent combinations of the stored data. The usual information stored concerning your securities is:

1. Ownership, husband, wife, or both.
2. Name of the security.
3. Number of shares.
4. Date of purchase.
5. Cost.
6. Dividend.
7. Recent quote.

A BASIC program for typical practical outputs is the subject of this article as shown in the program listing (Fig. 1). This program is written in Altair Disk Extended BASIC but may be used with some small alterations in almost any BASIC interpreter. The PRINT USING statements (see lines 320 and 470) are nice, as they make the figure columns line up, but are not absolutely necessary. If your BASIC does not have this feature and you still want to line up your figures, an alternative is to use the method shown in Example 1.

The security information is stored in the form of DATA statements, and the last DATA statement, line 1270, is used to stop the data reading and proceed to the remainder of the program. There are no special tricks in the program. One handy device is to use the loop in line 510 to print a series of

---

For BASIC interpreters not having PRINT USING numerical data can be columnized at the decimal point by an automatic adjustment of the TAB. Using the statement PRINT TAB(Y-INT(LOG(X)/LOG(10)))X will do the trick for numbers equal to or greater than 0.10 where Y is the TAB number and X is the number to be printed. The restriction is of no consequence as a figure in this program of less than ten cents will hardly appear alone. (See Fig. 4.)

Example 1.

"-" in order to produce a dashed line.

The program first asks for the date that presumably would be associated with the "Quote" prices in the DATA. The program then asks for a decision as to whether husband, wife, or both are wanted. Note that the social security numbers are included as part of the program. The program then asks for a decision as to whether divided or value analysis is required.

If "Value" is selected the program drops to line 226 and ends at line 370. If "Dividend" is selected, the program goes to line 380 and ends at line 560. Either of these subprograms manipulates the data and outputs the desired results at line 320 or 470. The selection for husband, wife, or both is done in line 140 which determines the string value of O$ which is used in lines 160, 170, 250, 260, 420, and 430.

This program does not use the date of purchase of the security, but having this data listed in the file makes the data complete and it can be

```
100 INPUT "DATE";E$
105 INPUT "DIVIDEND OR VALUE (D OR V)";J$
110 J$=LEFT$(J$,3)
130 S1=0:V=0:F=0:G1=0:C1=0:D4=0
140 INPUT "HUSBAND, WIFE, OR BOTH. (H, W, OR B) ";O$
150 PRINT:PRINT
160 IF O$="H" THEN PRINT " JOHN P. SMITH, 196-24-7182":GOTO 200
170 IF O$="W" THEN PRINT " JANET R. SMITH, 065-42-1215":GOTO 200
180 PRINT" JOHN P. (H) & JANET R. (W) SMITH"
190 PRINT " 191-24-7082  065-38-0215"
200 PRINT:PRINT "  ";E$:PRINT
210 IF J$="D" THEN 380
226 PRINT " STOCK VALUE ANALYSIS"
227 PRINT
228 PRINT"    STOCK         SHARES       PRICE        COST          VALUE         GAIN"
230 PRINT
240 READ H$,A$,S,D$,C,D,Q
245 IF H$="X" THEN 350
250 IF O$="B" THEN 270
260 IF O$ <> H$ THEN 340
270 V=S*Q
280 G=V-C
290 S1=S1+V
300 C1=C1+C
305 G1=G1+G
310 K$="\\ \          \    ####       ##.#       ##,###         ###,###        ###,###"
315 M$=" \            \                      $###,###        $###,###       $###,###"
318 L$="TOTALS"
320 PRINT USING K$;H$,A$,S,Q,C,V,G
340 GOTO 240
350 FOR I=1 TO 72:PRINT "-";:NEXT:PRINT
360 PRINT USING M$;L$,C1,S1,G1
370 END
380 PRINT"STOCK DIVIDEND ANALYSIS":PRINT
390 PRINT"    NAME          SHARES       DIV          DIV/COST%    DIV/VAL%   DIV"
400 PRINT
410 READ H$,A$,S,D$,C,D,Q
415 IF H$="X" THEN 510
420 IF O$="B" THEN 435
430 IF O$ <> H$ THEN 500
435 V=S*Q
440 D1=S*D
450 D2=INT(1000*D1/C)/10
455 U$="\\ \          \    ####      ###.##   ##.#          ##.#      ##.#     #,###"
460 D3=INT(1000*D1/V/10
465 R$="TOTAL YEARLY DIVIDENDS"
470 PRINT USING U$;H$,A$,S,D,D2,D3,D1
475 T$="           \                              \                  $###,###"
480 D4=D4+D1
500 GOTO 410
510 FOR I=1 TO 72:PRINT "-";:NEXT:PRINT
530 PRINT USING T$;R$,D4
540 PRINT
550 PRINT"    * DIVIDENDS HAVING PARTIAL CAPITAL GAINS."
560 END
1010 DATA H,AT&T,100,54-61,2904,4.2                     63.1
1030 DATA W,BEAT.FDS,200,1/9/54,662,.8,                 24.9
1040 DATA W,BETH ST,200,6/8/56,7243,2,                  35.4
1060 DATA W,CITICORP,100,55-57,701,.94,                 28.4
1070 DATA H,COL.PALM.PT.,300,12/7/56,772,.82,           25.1
1080 DATA W,COM.ED.,135,54-72,2865,2.69,                29.4
1130 DATA W,FREEDOM FUND *,345,11/22/69,3543,.246,       8.1
1140 DATA W,GEN.ELEC.,100,60-67,2665,1.8,               49.5
1150 DATA H,GEN.MOT.,100,9/30/55,4801,5.55,             67.7
1160 DATA W,INA,200,1952,2828,2.1,                      41.6
1220 DATA W,PHILLIPS PET.,100,54-64,2064,1.75,          55.5
1230 DATA W,REYIN,200,1/19/54,1941,3.13,                64
1260 DATA W,WESTVACO,300,8/23/54,1888,1.025,            32
1270 DATA X,X,0,X,0,0,0
```

Fig. 1. Program listing.

used for reference if needed. The quote figures are put last and in a column to aid in editing these figures for any periodic update.

In my particular application I use one file for DATA program and one file for the operating program, and I use the MERGE command before running. This feature is not necessary but it does cut down on storage space for historical quote data.

Two sample runs are shown for this program. The input data from the keyboard is shown as underlined in the first three requests. The first sample run (Fig. 2) shows a dividend analysis for both husband and wife. The second sample run (Fig. 3) shows a value analysis for the wife only. By proper inputs after RUN, any of six different analyses can be obtained. ■

```
LIST

10 READ X
20 T=INT(LOG(X)/LOG(10))
30 PRINT TAB(25-T)X
35 GOTO 10
40 DATA 123.26,56.45,1.62,.73,.08

OK
RUN
                        123.26
                         56.45
                          1.62
                           .73
                           .08
```

Fig. 4. A substitute for PRINT USING.

```
RUN
DATE? 1/5/77
DIVIDEND OR VALUE (D OR V)? D
HUSBAND, WIFE, OR BOTH. (H, W, OR B)? B

   JOHN P. (H) & JANET R. (W) SMITH
   191-24-7082     065-38-0215

   1/5/77

STOCK DIVIDEND ANALYSIS
   NAME                         SHARES     DIV       DIV/COST%          DIV/VAL%       DIV

H     AT&T                        100      4.20        14.4               6.6          420
W     BEAT.FDS                    200      0.80        24.1               3.2          160
W     BETH ST                     200      2.00         5.5               5.6          400
W     CITICORP                    100      0.94        13.4               3.3           94
H     COL.PALM.PT.                300      0.82        31.8               3.2          246
W     COM.ED.                     135      2.69        12.6               9.1          363
W     FREEDOM FUND *              345      0.25         2.3               3.0           85
W     GEN.ELEC.                   100      1.80         6.7               3.6          180
H     GEN.MOT.                    100      5.55        11.5               8.1          555
W     INA                         200      2.10        14.8               5.0          420
W     PHILLIPS PET.               100      1.75         8.4               3.1          175
W     REYIN                       200      3.13        32.2               4.8          626
W     WESTVACO                    300      1.03        16.2               3.2          308
---------------------------------------------------------------------------------------------
                         TOTAL YEARLY DIVIDENDS                                  $ 4,032

   * DIVIDENDS HAVING PARTIAL CAPITAL GAINS.
```

Fig. 2. RUN of Stock Dividend analysis.

```
OK
RUN
DATE? 1/5/77
DIVIDEND OR VALUE (D OR V)? V
HUSBAND, WIFE, OR BOTH. (H, W, OR B)? W

   JANET R. SMITH, 065-42-1215

   1/5/77

   STOCK VALUE ANAYSIS

   STOCK                   SHARES      PRICE        COST         VALUE       GAIN

W  BEAT.FDS                 200         24.9          662         4,980      4,318
W  BETH ST                  200         35.4        7,243         7,080      - 163
W  CITICORP                 100         28.4          701         2,840      2,139
W  COM.ED.                  135         29.4        2,865         3,969      1,104
W  FREEDOM FUND *           345          8.1        3,543         2,795      - 748
W  GEN.ELEC.                100         49.5        2,665         4,950      2,285
W  INA                      200         41.6        2,828         8,320      5,492
W  PHILLIPS PET.            100         55.5        2,064         5,550      3,486
W  REYIN                    200         64.0        1,941        12,800     10,859
W  WESTVACO                 300         32.0        1,888         9,600      7,712
--------------------------------------------------------------------------------------
 TOTALS                                          $ 26,400      $ 62,884   $ 36,484

OK
```

Fig. 3. RUN of Stock Value analysis.

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We are proud to announce the arrival of the newest member to the Seals' family of performance products... **the PUP-1 Peripheral Universal Processor.** The PUP-1 was designed with the same reliability and attention to detail that has enabled Seals' products to set the quality standards for the industry. The PUP-1 was designed from the ground up to meet all the needs and demands placed on a continuous-duty micro computer by OEM applications.

The standard software package for the PUP-1 includes **DOS, EXTENDED BASIC, SAMPLE BUSINESS,** and **DISC OPERATING ROUTINES.** To make repairs more simple, should a malfunction occur, the PUP-1 comes with a **diagnostic program** that will locate the exact area of dysfunction.

The PUP-1 is fully operational in temperatures from **0-55° C** and can run on AC line voltages available anywhere in the world.

Designed to deliver reliability, performance and maintenance-free operation, the PUP-1 makes optimum cost effectiveness available for you.

PUP-1 SPECIFICATIONS

PROCESSOR
8-bit Z-80 CPU 2.5 MHz standard 4MHz option/other CPUs available.

STANDARD SOFTWARE
EXTENDED BASIC, DOS, diagnostics, sample business and disc operating routine.

BUS
Completely S-100 Compatible. All accepted signals including 'P-sync' and 'Refresh'. Plug-in terminators on 16 address lines, 8 data in, and 8 data out lines.

MEMORY
32K standard. Expandable to 0.5 Megabyte without additional power or extended mother-board.

DISK DRIVE
Built-in dual 'Shugart' mini-floppy standard. 86K per disk. Also available without disk or with one drive only (Double Density Coming).

I/O
Standard ports: 2 serial, 2 parallel. Each completely independent (any port may be run at any address). Addresses switch-selectable with software override. 50 to 19,200 baud.

POWER SUPPLY
Full-load rating + 8V @ 23A, + 18V @ 6A, -18V @ 6A
Input 95 - 125V ac and 195 - 250V ac, 50-60Hz,
Oversize rectifiers 50A + 8V, 25A ± 16V

FRONT PANEL
Push Buttons: 'INITIALIZE', 'RESET', 'STOP'
Indicators: 'RUN', 'WAIT', 'SINP', 'SOUT'.
Security Lock: 'OFF', 'INITIALIZE', 'RUN', 'PROTECT'.

REAR PANEL
9 cutouts for standard 25 pin EIA connector. 2 cutouts for standard 37 pin EIA connector. 2 cutouts for standard 15 pin EIA connector. 2 D holes for BNC connectors. Off-On Switch (main power). Fused main power.

MECHANICAL
Free-standing (rack mounting optional)
11-connector mother-board. Rigid main chassis.
Removable front panel.
Card-cage containing all components, except power supply and listed front and rear panel controls and connectors, removable for servicing.

OPERATING TEMPERATURE
Full specification at ambient 0-55°C.

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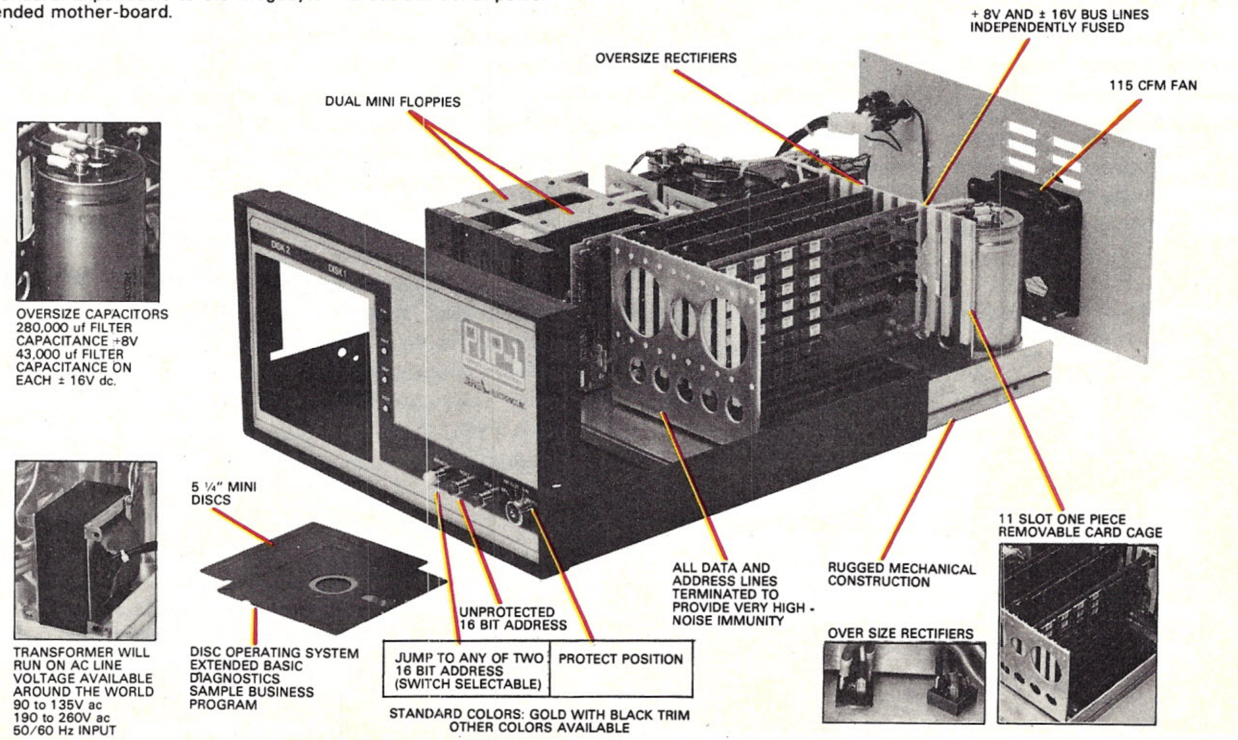


Don Rindsberg
The Bit Stop
PO Box 973
Mobile AL 36601

Here's HUEY!

. . . super calculator for the 6502

What hobbyist wouldn't like to have available the calculating power of FORTRAN in his system? Here is HUEY, written for the 6502 microprocessor, which does arithmetic with precision better than an IBM 360/370 or Univac 1108, unless they pull a dirty trick and switch to double-precision mode. What's more, HUEY (please don't call him Hewlett) operates from your ASCII keyboard like a calculator; will output through your routines to a TV screen or Teletype; is preprogrammed to do trig functions, natural and common logs, exponential functions and other goodies; and is programmable for many other functions (financial, accounting, mathematics, engineering, etc.) you would like to call at the press of a single key. Further, the routines can be called as subroutines by your own programs if you need the precision or the functions HUEY provides.

All this is contained in 2.5K of memory, with optional expansion to 3K by addition of your own functions.

The complete hexadecimal listing of the program is given in Table 1. The basic program occupies addresses 1000 through 19FF, but you will wish to reserve 1AOO through 1BFF if you intend to add other functions. The program uses page zero extensively for arithmetic registers and memory registers, and you should avoid using addresses 0020 through 009F for your video routines or other programs. The program itself sets all these locations at the values it wants, so there is no extensive entry into page zero required before the program can be used. Arithmetic overflow, division by zero, logs of negative numbers and other no-nos divert the program to software breaks. If you set your IRQ vector to go to address 1164, a break will give you an error code on your display. This code, shown in Table 2, is simply the address of the break, plus two. The error code will be followed by a string of zeros on the next line.

1006	4C,xx,yy	A jump to your input routine. xx is ADL, yy is ADH.
1009	4C,xx,yy	A jump to your output routine.
100C	5C	Choice of default character.
100D	2A	Choice of exponent symbol.
100E	09	Number of digits entered or displayed. Enter number between 02 and OD.
100F	08	Choice of back space code.
1010	00	Expansion.
1011	01	Delay time for typewriter carriage return. Use 01 for shortest time. FF for longest. FF gives 0.3 sec for 1 MHz clock.
1012	1B	Character used to TAB to exponent.
1013	00	Expansion.

Program A.

Entering the Program

For ease of entry, all of the basic user options in the program are contained in the first few bytes of the listing. Program A will allow you to select the options and provide entry to your input/output routines. Although the accesses to your input and output routines appear to be jumps, in all cases they originate deep within the inner workings of the program as jumps to subroutines. So, when your input or output routine is through doing its thing, however long it takes, it must end with op code 60 (return from subroutine). Just to be safe, set Y to zero just before returning, although I thought this kind of bug was exterminated prior to printing.

The request by the program to output a character is, in all cases, preceded by instructions within the program to place the ASCII character in the accumulator of the microprocessor. Similarly, when it asks for an input, it expects its ASCII equivalent to be in the accumulator. Your routines should restore the stack pointer, since the stack has what your mail should have on the upper left corner — namely, the return address. If you have Tiny BASIC, identical input/output routines can be used.

Press Go, Start, or Whatever

Your initialization routines can do whatever you like (clear the TV screen, set the IRQ vector or turn on the coffee), but when they are finished, there should be a

Code	Description
14F9	Overflow in Exponent calculation.
157D	Square root of negative number.
15C7	Natural log of negative number or zero.
16E6	Floating point overflow (number too large).
176F	Division by zero.

Table 2. Error codes.

```
1ØØØ  4C 14 1Ø 4C 1B 1Ø 4C ØØ ØØ 4C ØØ ØØ 5C 2A Ø9 Ø8
1Ø1Ø  18 Ø1 1B ØØ AØ 8Ø A2 2Ø 2Ø 94 13 A2 FF 9A D8 A9
1Ø2Ø  2Ø 85 9Ø A9 6Ø 85 93 2Ø Ø7 17 2Ø 56 17 2Ø 73 17
1Ø3Ø  AØ ØØ 84 9F A9 81 85 9E EA EA EA EA EA A9 3A 2Ø
1Ø4Ø  Ø9 1Ø 2Ø Ø6 1Ø AØ ØØ D8 29 7F CD ØF 1Ø FØ 4A CD
1Ø5Ø  12 1Ø DØ Ø3 4C E6 1Ø C9 2A 9Ø E7 C9 5B BØ E3 C9
1Ø6Ø  3Ø 9Ø 3E C9 3A BØ 3D E9 2F 85 9D A5 9E C9 81 DØ
1Ø7Ø  Ø3 2Ø 56 17 A5 9E 38 ED ØE 1Ø C9 83 FØ 1D C9 8Ø
1Ø8Ø  FØ 11 A5 9E C9 81 38 DØ Ø1 18 2Ø ØØ 17 BØ B3 A9
1Ø9Ø  2E 9Ø AC 2Ø D2 17 38 BØ F1 C6 9E AE ØC 1Ø 4C 93
1ØAØ  11 18 69 ØA 85 9D 2Ø 34 17 2Ø Ø7 17 AØ ØØ 84 4E
1ØBØ  A9 18 85 4F 2Ø ØØ 11 A6 9D BD CC 14 AA 2Ø CE 1Ø
1ØCØ  A9 Ø8 85 4E A9 18 85 4F 2Ø ØØ 11 4C 3Ø 1Ø 29 Ø3
1ØDØ  18 69 18 85 4F 8A 29 FC 85 4E 4C ØØ 11 E6 4E DØ
1ØEØ  Ø2 E6 4F 6Ø ØØ ØØ A9 81 18 6D ØE 1Ø C5 9E DØ Ø6
1ØFØ  2Ø D2 17 4C 42 1Ø A9 3Ø 2Ø Ø9 1Ø E6 9E DØ E7 EA

11ØØ  AØ ØØ B1 4E FØ ØC 2Ø 13 11 38 E6 4E DØ Ø2 E6 4F
111Ø  BØ EE 6Ø Ø8 48 29 7E AA BD ØØ 12 85 91 BD Ø1 12
112Ø  85 92 68 28 3Ø Ø6 4A BØ Ø6 4C 9Ø ØØ 4C AE 12 4C
113Ø  DØ 12 A5 2Ø C9 6Ø BØ ØB A9 F2 85 91 A9 12 85 92
114Ø  2Ø AE 12 6Ø A5 2Ø FØ Ø3 4C Ø3 13 AØ 1Ø A2 7Ø 4C
115Ø  94 13 A5 72 DØ ØB A2 73 DØ Ø7 A2 2Ø AØ Ø7 4C 94
116Ø  13 4C Ø3 14 68 68 85 9A 68 2Ø 74 11 A5 9A 2Ø 74
117Ø  11 4C 1B 1Ø 48 4A 4A 4A 4A 2Ø 89 11 2Ø Ø9 1Ø 68
118Ø  29 ØF 2Ø 89 11 2Ø Ø9 1Ø 6Ø C9 ØA BØ Ø3 69 3Ø 6Ø
119Ø  69 36 6Ø 98 91 9E 8A EA EA 4C 3F 1Ø ØØ ØØ ØØ ØØ
11AØ  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 7F 4Ø ØØ ØØ
11BØ  ØØ ØØ ØØ 82 4Ø ØØ ØØ ØØ ØØ ØØ ØØ 7F 58 B9 ØB FB E8
11CØ  E6 7E 6F 2D EC 54 9B 92 8Ø 5A 82 79 99 FC E4 8Ø
11DØ  52 BØ 3D 8Ø ØØ ØØ 81 AB 86 49 1Ø ØØ ØØ 8Ø 6A Ø8
11EØ  65 1Ø ØØ ØØ 86 57 6A EØ FF ØA 8Ø 89 4D 3F 1D ØØ
11FØ  ØØ ØØ 7B 46 FA 7Ø ØØ ØØ ØØ 83 4F A3 Ø3 4D ØØ ØØ

12ØØ  ØØ ØØ 5Ø 16 4A 16 77 16 66 17 77 15 85 15 73 17
121Ø  1C 16 8Ø 12 BF 15 D5 14 F8 14 ØØ 14 ØØ 13 2C 16
122Ø  E8 16 55 15 5B 15 6A 15 DE 12 96 12 Ø7 17 56 17
123Ø  32 11 DE 17 FA 17 ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
124Ø  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 2A 15 AC 11 B3 11 37 ØØ
125Ø  47 ØØ 57 ØØ 2Ø ØØ F2 12 F9 12 CØ 14 C7 14 CE 14
126Ø  95 12 31 15 38 15 3F 15 46 15 4D 15 BA 11 C1 11
127Ø  C8 11 CF 11 D6 11 DD 11 E4 11 EB 11 F2 11 F9 11
128Ø  A2 Ø6 B5 4Ø 95 3Ø B5 5Ø 95 4Ø B5 6Ø 95 5Ø B5 67
129Ø  95 6Ø CA 1Ø ED 6Ø A2 Ø6 B5 2Ø B4 3Ø 95 3Ø B5 4Ø
12AØ  94 4Ø B4 5Ø 95 5Ø 94 2Ø CA 1Ø ED AØ ØØ 6Ø A2 Ø6
12BØ  AØ Ø6 B5 6Ø 95 67 B5 5Ø 95 6Ø B5 4Ø 95 5Ø B5 3Ø
12CØ  95 4Ø B5 2Ø 95 3Ø B1 91 95 2Ø 88 CA 1Ø E4 C8 6Ø
12DØ  A2 26 AØ Ø6 B5 ØØ 91 91 CA 88 1Ø F8 C8 6Ø A2 Ø6
12EØ  B5 57 B4 2Ø 95 2Ø 94 57 CA 1Ø F5 6Ø ØØ ØØ ØØ ØØ
12FØ  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 8Ø 4Ø ØØ ØØ ØØ ØØ ØØ

13ØØ  4C 44 11 EA EA EA AØ ØØ 84 7Ø A5 21 1Ø Ø5 C6 7Ø
131Ø  2Ø 8F 16 AØ ØØ 84 71 A5 2Ø C9 7F FØ 32 9Ø 13 2Ø
132Ø  1C 16 2Ø B4 13 2Ø 9D 16 A5 71 2Ø A8 13 85 71 B8
133Ø  5Ø E5 C9 7A 9Ø Ø6 2Ø 5F 16 B8 5Ø DB 2Ø 1C 16 2Ø
134Ø  B4 13 2Ø 77 16 A5 71 2Ø AE 13 85 71 B8 5Ø C8 A2
135Ø  72 2Ø 92 13 A2 82 2Ø 92 13 A9 Ø5 85 82 A2 26 AØ
136Ø  Ø6 2Ø 9D 13 A9 3Ø 85 5F A2 26 AØ Ø6 2Ø 9D 13 C6
137Ø  5F FØ 11 9Ø Ø7 A2 7F AØ 8F 2Ø C4 13 A2 82 2Ø E2
138Ø  13 38 5Ø E4 A5 71 2Ø AE 13 85 71 EA EA EA EA EA
139Ø  EA 6Ø AØ ØE A9 ØØ 95 ØØ E8 88 DØ FA 6Ø 16 ØØ CA
13AØ  88 36 ØØ CA 88 DØ FA 6Ø 18 F8 69 Ø1 D8 6Ø 38 F8
13BØ  E9 Ø1 D8 6Ø A2 2Ø AØ Ø7 2Ø 94 13 A9 83 85 2Ø A9
13CØ  5Ø 85 21 6Ø A9 ØE 85 6F F8 18 B9 ØØ ØØ 75 ØØ 48
13DØ  29 ØF 95 ØØ 68 29 1Ø FØ Ø1 38 CA 88 C6 6F DØ EA
13EØ  D8 6Ø D8 A9 ØD 85 6F 56 ØØ 9Ø Ø8 E8 A9 Ø9 75 ØØ
13FØ  95 ØØ CA E8 C6 6F DØ EF EA EA 6Ø ØØ ØØ ØØ ØØ ØØ

14ØØ  4C 52 11 EA EA EA A5 71 2Ø A8 13 85 71 A2 2Ø AØ
141Ø  Ø7 2Ø 94 13 A9 8Ø 85 2Ø 4A 85 21 A5 71 A8 FØ 23
142Ø  18 F8 69 5Ø C9 5Ø D8 9Ø ØD 98 2Ø AE 13 2Ø 99 14
143Ø  2Ø 77 16 B8 5Ø E5 98 2Ø A8 13 2Ø 99 14 2Ø 9D 16
144Ø  B8 5Ø D8 2Ø 1C 16 A2 2Ø AØ Ø7 2Ø 94 13 A2 67 AØ
145Ø  Ø7 2Ø 94 13 A9 4Ø 85 68 A9 2F 85 5E 2Ø A2 14 9Ø
146Ø  ØB A2 Ø6 B5 67 15 2Ø 95 2Ø CA DØ F7 18 A2 FA A9
147Ø  8Ø BØ Ø1 ØA 57 6E 15 6E 95 6E E8 DØ F2 C6 5E DØ
148Ø  DB A9 7F 85 2Ø A5 7Ø 3Ø ØA 2Ø 3E 16 2Ø 77 16 EA
149Ø  EA EA 6Ø 2Ø 8F 16 B8 5Ø F3 85 71 2Ø 1C 16 2Ø B4
14AØ  13 6Ø A2 7F AØ ØE F8 18 B5 ØØ 75 ØØ 48 29 ØF 95
14BØ  ØØ 68 29 1Ø 18 FØ Ø1 38 CA 88 DØ EC D8 6Ø ØØ ØØ
14CØ  7F 8Ø ØØ ØØ ØØ ØØ ØØ 81 4Ø ØØ ØØ ØØ ØØ ØØ 81 6Ø
14DØ  ØØ ØØ ØØ ØØ ØØ A5 22 85 2F 38 E9 7C A5 21 E9 ØØ
14EØ  1Ø 15 18 A5 22 69 78 A5 21 69 ØØ 1Ø Ø9 A9 ØØ A2
14FØ  Ø6 95 2Ø CA 1Ø FB 6Ø ØØ 38 A5 2F 65 2Ø 85 2Ø 6Ø

15ØØ  1C 64 6Ø 7Ø 6Ø 28 6Ø 6Ø 3C 6Ø 38 B1 34 6D 6Ø 55
151Ø  6Ø BØ 6Ø 65 6Ø 48 6Ø 45 8Ø 6Ø 5Ø 6Ø 14 EØ 7C Ø1
152Ø  75 4Ø 44 24 58 6Ø 6Ø 6Ø 6Ø 6Ø 8Ø 4Ø ØØ ØØ ØØ ØØ
153Ø  2Ø 82 5Ø ØØ ØØ ØØ ØØ ØØ 82 9Ø ØØ ØØ ØØ ØØ ØØ 83
154Ø  5Ø ØØ ØØ ØØ ØØ ØØ 81 56 FC 2A 2C 51 5E 81 64 87
155Ø  ED 51 1Ø B2 ØØ A9 Ø9 EA 85 97 6Ø A5 4E 85 95 A5
156Ø  4F 85 96 6Ø ØØ ØØ ØØ ØØ ØØ ØØ C6 97 FØ Ø8 A5 95
157Ø  85 4E A5 96 85 4F 6Ø A5 21 1Ø Ø1 ØØ A5 2Ø 85 98
158Ø  A9 8Ø 85 2Ø 6Ø A9 ØØ 85 99 46 98 9Ø Ø2 E6 99 Ø6
159Ø  98 A5 98 1Ø Ø9 38 E9 8Ø 4A 18 69 8Ø 9Ø Ø9 A9 8Ø
15AØ  38 E5 98 4A 18 65 98 85 2Ø A5 99 FØ 11 A9 C8 85
15BØ  91 A9 11 85 92 2Ø AE 12 2Ø 77 16 2Ø 8Ø 12 6Ø A5
15CØ  21 FØ Ø2 1Ø Ø1 ØØ 2Ø 1C 16 A2 8Ø 46 3E A5 3Ø 3Ø
15DØ  Ø7 86 3E 38 A9 ØØ E5 3Ø 86 3Ø 38 E9 8Ø 85 22 A9
15EØ  ØØ 85 21 2Ø 2C 16 Ø6 3E 9Ø ØB A2 Ø5 A9 ØØ F5 21
15FØ  95 21 CA 1Ø F7 6Ø 2Ø 94 13 A9 8E 85 2Ø 4C 3E 16

16ØØ  18 A2 Ø5 B5 21 75 31 95 21 CA 1Ø F7 6Ø Ø6 94 2Ø
161Ø  12 16 24 21 1Ø Ø5 2Ø 8F 16 E6 94 38 A2 Ø7 94 26
162Ø  B5 1F B4 2F 94 1F 95 2F CA DØ F3 6Ø A2 23 AØ Ø7
163Ø  4C F6 15 C6 2Ø Ø6 26 A2 Ø5 36 2Ø CA DØ FB A5 21
164Ø  ØA 45 21 3Ø Ø4 A5 2Ø DØ EA 6Ø 2Ø 8F 16 2Ø 5D 16
165Ø  A5 3Ø C5 2Ø DØ F7 2Ø ØØ 16 5Ø E3 7Ø Ø5 9Ø BD A5
166Ø  21 ØA E6 2Ø FØ 7E A2 F4 A9 8Ø BØ Ø1 ØA 56 2D 15
167Ø  2D 95 2D E8 DØ F2 6Ø 2Ø ØD 16 65 2Ø 2Ø CD 16 18
168Ø  2Ø 66 16 9Ø Ø3 2Ø ØØ 16 88 1Ø F5 46 94 9Ø AF 38
169Ø  A2 Ø6 A9 ØØ F5 2Ø 95 2Ø CA DØ F7 FØ BC 2Ø ØD 16
16AØ  E5 2Ø 2Ø CD 16 38 A2 Ø5 B5 31 F5 27 48 CA 1Ø F8
16BØ  A2 FA 68 9Ø Ø2 95 37 E8 DØ F8 A2 Ø6 36 2Ø CA DØ
16CØ  FB Ø6 36 A2 Ø5 2Ø F8 16 88 DØ DA FØ BE Ø8 2Ø EF
16DØ  16 28 EA BØ ØD 3Ø Ø4 68 68 9Ø B2 49 8Ø 85 2Ø AØ
16EØ  2F 6Ø 1Ø F7 ØØ 2Ø 5F 16 A5 2Ø C9 8E DØ F7 6Ø AØ
16FØ  Ø6 96 2Ø 88 DØ FB 6Ø EA 36 3Ø CA DØ FB BØ E5 6Ø

17ØØ  A5 9D 91 9E E6 9E 6Ø A9 ØD 2Ø Ø9 1Ø A9 ØA 2Ø Ø9
171Ø  1Ø AE 11 1Ø 88 DØ FD CA DØ FA 6Ø EA EA EA EA A2
172Ø  81 AØ 72 AD ØE 1Ø 85 9B B5 ØØ 99 ØØ ØØ E8 C8 C6
173Ø  9B DØ F5 6Ø 2Ø 1F 17 AE ØE 1Ø B5 81 ØA ØA ØA ØA
174Ø  15 82 85 71 A5 8Ø 85 7Ø B5 81 1Ø Ø8 F8 38 A9 ØØ
175Ø  E5 71 85 71 D8 6Ø A2 7Ø AØ 2Ø 2Ø 94 13 6Ø EA EA
176Ø  Ø9 3Ø 2Ø Ø9 1Ø 6Ø A5 2Ø FØ Ø3 4C 9D 16 ØØ ØØ ØØ
177Ø  ØØ ØØ ØØ A9 2Ø A6 7Ø 1Ø Ø2 A9 2D 2Ø Ø9 1Ø A5 72
178Ø  2Ø 6Ø 17 A9 2E 2Ø Ø9 1Ø AE ØE 1Ø CA 86 3E A2 ØØ
179Ø  86 3F A6 3F B5 73 2Ø 6Ø 17 E6 3F C6 3E DØ F3 AD
17AØ  ØD 1Ø 2Ø Ø9 1Ø A5 71 C9 5Ø 9Ø ØF A9 2D 2Ø Ø9 1Ø
17BØ  38 F8 A9 ØØ E5 71 D8 B8 5Ø Ø7 A9 2Ø 2Ø Ø9 1Ø A5
17CØ  71 48 4A 4A 4A 4A 2Ø 6Ø 17 68 29 ØF 2Ø 6Ø 17 4C
17DØ  Ø7 17 AD ØD 1Ø 2Ø Ø9 1Ø A9 2Ø 2Ø Ø9 1Ø 6Ø 2Ø DD
17EØ  1Ø AØ ØØ B1 4E AA A5 4E 48 A5 4F 48 8A 2Ø CE 1Ø
17FØ  68 85 4F 68 85 4E 6Ø ØØ ØØ ØØ A9 Ø3 85 97 6Ø ØØ

18ØØ  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 53 C8 Ø6 1C ØE 12 28 ØØ
181Ø  ØØ ØØ ØØ ØØ D4 D4 1A 12 ØØ ØØ ØØ ØØ D4 D4 12 12
182Ø  Ø6 12 ØØ ØØ EE ØØ ØØ ØØ D4 D4 12 12 Ø8 12 ØØ ØØ
183Ø  ØØ ØØ ØØ ØØ 2C 2E ØØ ØØ 4F ØØ ØØ ØØ CE ØØ ØØ ØØ
184Ø  EA ØØ ØØ ØØ E8 ØØ ØØ ØØ D8 1Ø Ø8 12 ØØ ØØ ØØ ØØ
185Ø  D4 D4 1A 12 DA Ø6 12 ØØ 1Ø ØØ ØØ ØØ ØØ ØØ ØØ ØØ
186Ø  ØØ ØØ ØØ ØØ D4 D4 12 12 Ø2 12 ØØ ØØ ØØ ØØ ØØ ØØ
187Ø  D4 D4 12 12 Ø4 12 3Ø ØØ ØØ ØØ ØØ ØØ 2A ØØ ØØ ØØ
188Ø  D4 14 51 1Ø 53 12 FØ Ø4 12 D2 FØ Ø2 12 Ø8 12 D4
189Ø  53 Ø6 12 F6 Ø4 12 F4 1Ø Ø8 12 F2 Ø2 12 D2 Ø6 12
18AØ  CA Ø2 12 DØ Ø2 12 EC Ø6 12 ØØ ØØ ØØ ØØ ØØ ØØ ØØ
18BØ  EC Ø8 12 D4 2Ø 16 1F Ø4 12 51 D4 Ø6 12 53 F8 Ø2
18CØ  12 FA 1Ø Ø8 12 FC D2 Ø6 12 1Ø Ø4 12 FE Ø2 12 DØ
18DØ  Ø4 12 DØ 1Ø Ø8 CA Ø2 12 18 12 ØØ ØØ ØØ ØØ ØØ ØØ
18EØ  ØA 53 1Ø 12 DC 22 24 51 1Ø 12 D2 DØ Ø8 12 DØ Ø2
18FØ  12 DC Ø8 12 26 ØC ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ

19ØØ  53 D4 Ø6 12 E6 Ø8 12 E6 Ø8 12 E6 Ø8 12 CA Ø8 12
191Ø  D8 Ø2 12 D8 1Ø Ø8 12 E6 Ø6 12 E4 Ø2 12 D2 Ø6 12
192Ø  DE Ø8 12 E2 Ø8 12 53 D4 Ø6 12 51 CC Ø6 12 CC Ø6
193Ø  12 CC E2 Ø6 12 6Ø Ø4 12 DØ Ø6 12 E2 Ø2 12 D2 Ø6
194Ø  12 ØØ ØØ ØØ 34 2A 24 53 C8 Ø6 1C ØE 12 28 2A 26
195Ø  ØØ ØØ ØØ ØØ EA DC Ø8 12 1Ø Ø4 12 32 Ø1 ØØ ØØ ØØ
196Ø  ØØ ØØ ØØ ØØ 32 8Ø EE Ø6 12 ØØ ØØ ØØ EE Ø8 12 32
197Ø  BØ ØØ ØØ ØØ 32 Ø1 D4 D4 Ø6 12 D8 1Ø Ø4 12 32 EØ
198Ø  Ø8 12 ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
199Ø  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
19AØ  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
19BØ  32 DD 32 DD D4 Ø6 DA Ø6 53 E2 CC Ø6 D8 Ø4 51 D8
19CØ  22 24 D2 Ø6 DØ Ø8 DØ DC Ø4 12 51 Ø6 D8 Ø2 26 D2
19DØ  DA Ø6 12 32 EØ Ø6 CC Ø6 ØØ ØØ ØØ ØØ D4 D4 Ø6 12
19EØ  D8 Ø2 12 32 EØ D8 Ø2 12 Ø8 12 ØØ ØØ ØØ ØØ ØØ ØØ
19FØ  ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
```

Table 1. Complete hex listings of program.

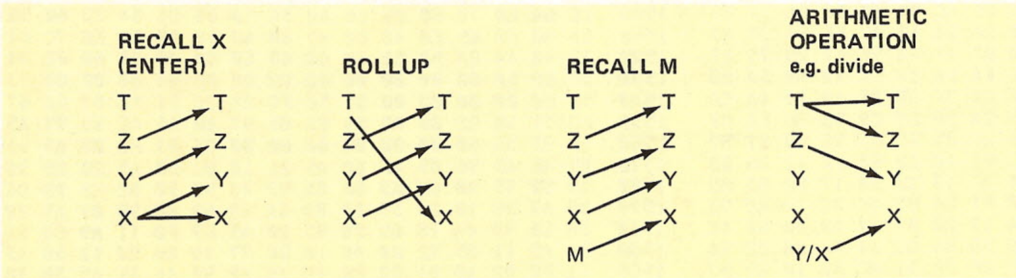


Fig. 1. Stack operations.

0020-26	X-register
0027-2D	E-register
002E	Exponent
002F	Integer
0030-36	Y-register
0037-3D	Memory M1
003E	Temporary used by ln and line output
003F	Temporary used by line output
0040-46	Z-register
0047-4D	Memory M2
004E/4F	String pointer
0050-56	T-register
0057-5D	Memory M3
005E	Counter
005F	Counter
0060-66	U-register
0067-6D	V-register and scratch
006E/6F	Temporary for decimal conversion
0070-7F	Main decimal register D
0080-8F	Decimal scratch and line buffer
0090	20 (JSR op code)
0091/92	Address of next routine
0093	60 (RTS op code)
0094	Sign
0095/96	Return address
0097	Counter
0098	Exponent
0099	Flag for SQRT
009A	Temporary used by break routine
009B	Counter
009C	(Expansion)
009D	Last key
009E/9F	Line buffer pointer

Table 3. Page zero assignments.

ADDRESS	DATA	FUNCTION
1526	83	Sets Z key to call address 1B80
1B80	EA	Recall pi
1B81	08	Divide
1B82	12	Move stack down after arithmetic
1B83	32	Set up to call string as subroutine
1B84	EO	Square root string
1B85	00	End

Program B.

jump to HUEY's point of COLD START at address 1000. HUEY will set the stack the way he likes, clear his registers in page zero, output a line of zeroes and output a colon, which is his way of telling you that he's waiting for you to press a key. The screen or typewriter should look like this:

```
0.00000000* 00
:
```

By the way, to keep the program short, I had to limit HUEY's vocabulary to scientific notation. That means all entries should have the decimal point after the first digit, and the number that follows the star is the power of ten that multiplies the first part.

OK, let us determine what 1 divided by 3 is, and we will then go on to more glamorous experiments. Press 1; press P (to enter the *positive* number you have just pressed into the X-register). Your display will now show:

```
:1.P
 1.00000000* 00
:
```

Note that HUEY has forced you to use scientific notation by typing a decimal point immediately following your 1, and has displayed the contents of the X-register. HUEY displays the X-register after every function, just like your $9.95 pocket calculator (at this point you may ask why you paid 100 times this amount for your system, but read on!).

Next, press 3, and then P. The display should now show 3 in our notation. Now, let us divert for one moment to check our work. Let's press K to see what the HUEY stack of four registers contains. The display should be as follows, except that the X, Y, Z and T are not actually displayed.

```
  :K
T  0.00000000* 00
Z  0.00000000* 00
Y  1.00000000* 00
X  3.00000000* 00
  :
```

HUEY has just displayed the X, Y, Z and T registers in reverse order to enable you to examine them more naturally. The entry of 3 into X pushed the previously entered 1 into the Y-register. Now press / to divide Y by X, and the display should show 3.33333333*-01, which means 0.333333333 in ordinary terms, since the minus 01 exponent indicates the decimal point moves one place to the left.

Let's re-examine the stack at this point by pressing K. Note that both dividend and divisor are lost in the arithmetic process, and that Z has moved to Y; in the process T remains unchanged, but is duplicated in Z.

```
:K
 0.00000000* 00
 0.00000000* 00
 0.00000000* 00
 3.33333333*-01
:
```

These features of the stack may or may not have anything to do with HUEY's name. The stack operations, by the way, are outlined in Fig. 1. For clarity of display on a TV screen or typewriter, the ROLL operation has been reversed from that used by hand calculators of similar name. You may load up to four numbers into the stack and then perform your arithmetic functions by combinations of rolls, X/Y exchanges, stores in memory, recalls, interspersed with arithmetic commands; and any time you have lost track of what is in the stack, just press K. All arithmetic operations are done on X and Y, without losing Z and T. There is no need to clear the stack registers; just enter new numbers, and the old ones disappear off the top.

Want to enter an exponent without entering all those zeros? Press ESC (or whatever ASCII key you have selected for this function at 1012) and HUEY will fill in the zeros for you. Negative numbers? Just press N instead of P to enter your number as a negative value. Negative exponents? Subtract your desired negative value from 100 and enter the result. For example, if you want to enter -09 as an exponent, enter 91. HUEY will echo the value he read so you can be sure. In this case, the echoed exponent will read -09. Back

X-register 0020-0026	E-register 0027-002D	Flags, etc.
Y-register 0030-0036	Memory M1 0037-003D	
Z-register 0040-0046	Memory M2 0047-004D	
T-register 0050-0056	Memory M3 0057-005D	
U-register 0060-0066	V-register 0067-006D	
D-register (decimal) 0070-007F		
B Decimal scratch 0080-008F		
Flags, counters, and pointers 0090-009F		

Fig. 2. Page zero memory map.

space works on both the number and the exponent, if you make a mistake, or you can press @ to clear your entry.

Sample Calculation

Suppose you have the area of a circle and want the radius. Simply use the sequence in Example 1.

If you have many values of radius you wish to calculate, you can preprogram, say, the Z key to do the entire operation with one keystroke, after the area is entered, as shown in Program B.

With these modifications to the program, you simply press number keys for the area, press P to enter as a positive number, and then your magic key Z. Repeat for as many calculations as you like. This simple illustration probably does not warrant preprogramming, but it illustrates the power of the system for more complicated calculations.

If you reset your system for any reason, you can re-enter HUEY at address 1003 for WARM START, which will not destroy the contents of the arithmetic registers.

HUEY recognizes, as functions, ASCII entries 2A through 2F (which includes the arithmetic functions) and 3A through 5A (all the upper-case letters and a few punctuation marks). All other ASCII entries are rejected, excepting, of course, the numbers and the special back space and tab functions. Preprogrammed functions are listed in Table 5.

Unused keys can be used for other functions. I have calculated such diverse things as compound interest, hyperbolic functions, 99-term power series and others by adding 12-60 byte programs to page 1A.

Numbers are limited in size to about 1.00000000* 37.

The Inner Workings

The arithmetic operations occupying page 16 are a floating point package originally printed in *Dr. Dobb's Journal*, but the package has been modified to use 47-bit arithmetic instead of the original 23-bit. (IBM single precision is 24 bits and Univac is 27.) Our 47 bits gives a precision to arithmetic operations of about 13 equivalent significant figures in decimal. The algorithms for ln, exp. sin, cos, tan and arctan can be counted on for eight-place accuracy, with the trig functions limited to the range 0-90 degrees or 0-pi/2 radians. Square root is performed with accuracy equivalent to the arithmetic operations.

The high precision is, of course, obtained at some sacrifice of speed, but this program is intended for the person who has some serious calculating to do, and not for the game-player who is satisfied with a number system allowing no fractions and having numbers limited to -32K to +32K.

The routines limiting the speed are the conversion of decimal to binary (page 14) and conversion of binary to decimal (page 13). This can be observed by the slowness of entry and display of very large and very small numbers, e.g., 1.00000000*-37.

Memory Registers

Although only one memory (M1) is preprogrammed for keyboard access, two other registers, M2 and M3, are used by the program to store intermediate results. In addition, the stack, which appears to the user to be four registers, is actually six registers X, Y, Z, T, U and V. The two extras are used to simplify restoring the contents of the four "visible" registers. Register E is used by the floating point package. All of these registers are 7-byte binary registers. All arithmetic is done in X, Y

The following functions are associated with number entry and stack manipulation:

P	Enter as positive number into X
N	Enter as negative number into X
@	Clear entry (use before P or N pressed)
K	Display stack contents
R	Roll the stack up (X to Y, Y to Z, Z to T, T to X)
X	Exchange X and Y

The following operate on X and Y and leave the result in X, with the stack dropping down to fill in; T is duplicated in Z:

+	X added to Y
-	X subtracted from Y
*	X multiplied by Y
/	Y divided by X

The following operate on X, leaving the other stack registers unchanged (arctan does bomb it):

A	Antilog X (base 10)
C	Cos X (radians)
E	Exponent (e raised to the X power)
G	Log X (base 10)
I	Inverse of X (1/X)
L	Natural logarithm of X
Q	Square root of X
S	Sin X (radians)
T	Tan X (radians)
?	Arctan X

The following functions are associated with memory and, in the case of recalls, push the stack up one notch:

Right Arrow	Store X in M
Left Arrow	Recall M into X
U	Recall pi into X (3.141592654)
V	Recall e into X (2.718281828)
W	Recall log e into X (0.434294481)

Table 5. Preprogrammed functions.

KEY	ACTION
Number Keys	Area
P	Enter as positive number
U	Recall pi
/	Divide to get A/pi
Q	Take square root

Example 1.

and E, and their original contents are stored elsewhere if restoration is desired.

In addition, register D is a 16-byte register that holds a number formatted in decimal, and register B acts as a line buffer and scratchpad. Fig. 2 shows the register locations in page zero. You can set up other registers in page zero if necessary.

Constants, such as pi, 0, 1 and SQRT2, are squeezed into available space throughout the program. Each constant requires seven bytes, and is in binary (hex) form. Other constants you may need, such as the tax rate on incomes over $150,000, can be stored anywhere in your memory, and can be accessed by way of empty slots in the address table. The location and hex values of the preprogrammed constants are shown in Table 4.

Address	Constant	Value (hex)						
12F2	0	00	00	00	00	00	00	00
12F9	1	80	40	00	00	00	00	00
14C0	-1	7F	80	00	00	00	00	00
14C7	2	81	40	00	00	00	00	00
14CE	3	81	60	00	00	00	00	00
1531	5	82	50	00	00	00	00	00
1538	-7	82	90	00	00	00	00	00
153F	10	83	50	00	00	00	00	00
1546	e	81	56	FC	2A	2C	51	5E
154D	pi	81	64	87	ED	51	10	B2
11BA	ln 2	7F	58	B9	0B	FB	E8	E6
11C1	log e	7E	6F	2D	EC	54	9B	92
11C8	SQRT 2	80	5A	82	79	99	FC	E4
11B3	4	82	40	00	00	00	00	00
11AC	0.5	7F	40	00	00	00	00	00
152A	1+	80	40	00	00	00	00	20

Table 4. Preprogrammed constants.

What Happens When You Press a Key?

When a function key is pressed, the ASCII value is used to look up a coded address in the table starting at 1500. The coded address refers to every fourth address in pages 18, 19, 1A and 1B. I have preprogrammed functions in the first two of these pages, leaving pages 1A and 1B for your own functions. At selected addresses in pages 18 and 19 are strings of microinstructions, each string ending in 00 to signal the end of the string. In turn, each microinstruction refers to a subroutine call instruction, a recall memory instruction or a store instruction. If bit 7 of the microinstruction is 1, a memory register is recalled to X. If bit 0 is a 1, then X is stored in a memory register. Otherwise, the microinstruction is decoded as a subroutine call. In all cases, the middle bits (1-6) of the micro refer to the address table occupying the first half of page 12, where the address of the subroutine or memory is picked up. After the current micro is executed, the program picks up the next, until it reaches 00. After the execution of a string of microinstructions, a common output string (located at 1808) is called by the mainline program. This exit string recalls a rounding constant a little bigger than 1, multiplies by X, converts the product to decimal, outputs the scientific format and restores the original contents of the stack. Note that rounding is applied only to the number being displayed and not to any binary registers, so that accuracy is maintained. For the purist, rounding can be easily disabled, but I hate to decode a string of nines!

A common entrance string is called by the mainline program, but it is not required at present and is disabled by the 00 at address 1800.

Because of the unique method of assembly of this program, that is, completely by hand, anyone wishing to reassemble to another memory location should work in whole pages, since some portions must stay in the same relative position on the page. Reassembly to start at address 4000, say, is relatively easy, but reassembly to start at address 4080 would be quite a chore.

A Sophisticated Example

When you have seen what the basic program will do, you may wish to calculate other functions. Let's say you want to preprogram for sinh(X), obtained by using the equation in Example 2.

```
sinh(X) = (e**X - e**-X)/2
```

Example 2.

Suppose you wish to use the H key for this function, and you wish to enter the string of microinstructions at address 1A80. At 1514, the H position in the table, enter 82. This 82 is derived from 80, the ADL of the string address, plus 2, the page offset from the base page 18. Now, enter a suitable string of microinstructions such as in Program C to solve your equation.

```
1A80   32   Set up to call a string as subroutine
1A81   BO   Call exponent string to get e**X
1A82   D4   Enter (make a duplicate copy in Y)
1A83   32   Set up to call string as subroutine
1A84   48   Call invert string to get e**-X
1A85   04   Subtract
1A86   12   Move stack down after arithmetic
1A87   DC   Recall number 2
1A88   08   Divide
1A89   12   Move stack down after arithmetic
1A8A   00   End
```

Program C.

With this short string, you can get sinh(X) each time the H key is pressed, or whenever the string is called by another string. Strings can be debugged by replacing any micro with 00 to stop the action at that point, and then pressing K to examine the stack.

A complete manual giving the details of this system, and including a documented listing of the program, is available from The Bit Stop, P.O. Box 973, Mobile AL 36601, for $20 postpaid. Tapes are also available.

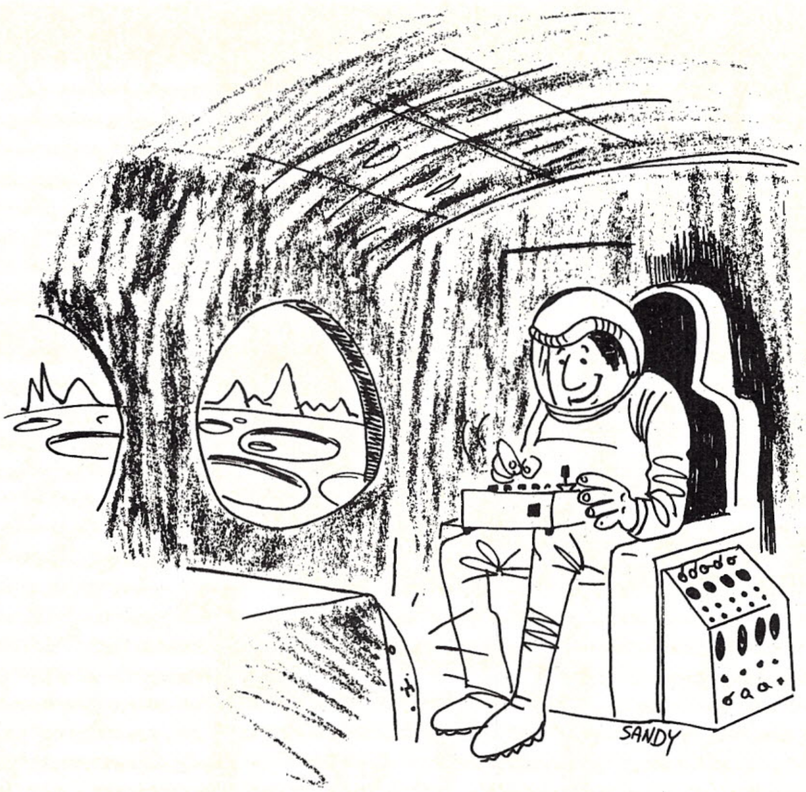
Encoding by use of microinstructions makes for a memory-efficient system, since each can call a machine-language subroutine using only one byte. Further, these microinstructions can set up loops to repeat a string as many times as desired, and can even call other complete strings as subroutines. All these features are illustrated in the arctan routine, which is about 60 bytes long, but results in calling some 200 machine-language subroutines before execution is complete.

My thanks go to Felton Mitchell, who got me off my can to write this, and who very kindly dumped off the hard copy. ■

Crash Landing !

. . . a real-time Lunar Lander game

Mark Borgerson
325 NW 9th #3
Corvallis OR 97330



Address	Hex Data	Decimal Data	Source Code
A014	(Data Storage)	Address is 40980_{10}	
A015	5F	95	CLRB
A016	86 34	134 52	LDAA #$34
A018	B7 8017	183 128 23	STAA $8017
A01B	B6 8016	182 128 22	LDAA $8016
A01E	5C	92	INCB
A01F	85 01	133 1	BITA #$01
A021	27 F8	39 248	BEQ (A01B)
A023	F7 A014	247 160 20	STAB $A014
A026	86 3C	134 60	LDAA #$3C
A028	B7 8017	183 128 23	STAA $8017
A02B	39	57	RTS

Program 2. Machine-Language code for the A-D convertor.

Previously we ran an article on the Lunar Lander game by Jim Huffman, and for that reason I was a little reluctant to run another one so soon. But, after reading Mark's version I just couldn't hold it back. It's neat! A real-time *version using analog-to-digital conversion which adds a whole new dimension to the game! Mark's article in Issue No. 3, entitled "Only Five Senses," describes the A/D circuit used. – John.*

The Lunar Lander game described here uses many of the features of 8K BASIC along with an A-D convertor to provide a game which is quite different from the usual game of this sort. In this game the lunar lander module comes under the control of the player at an altitude of 5000 meters and the amount of fuel to burn in each 2-second interval is set by a voltage input to the A-D convertor. At the end of each interval the computer will print out the number of seconds since the start of the game, the altitude in meters, the speed in meters/sec., the number of kilograms of fuel

remaining and the burn rate in the interval. At the end of the game the computer will give you the time of landing (or impact), the landing velocity in kilometers per hour and the number of kilograms of fuel remaining. You will also be rated on your proficiency as a pilot.

The BASIC program to accomplish these things is listed as Program 1. There are some features of this program which need more explanation than is given in the REM statements in the program. The first thing to note is that there are no built-in playing instructions in the program. There are several reasons for this, but the most important reason is that such instructions use up a lot of memory. I realize that most of the games you will find in the more popular books on computer games include built-in instructions, however, most of these games were written for use on time-sharing networks, not for home computers. These two types of computer systems require different approaches to program documentation. A home computer is seldom used very far from the documentation notebook or hard copy of the instructions. A time-sharing terminal can be located many miles from the computer and the hard-copy instructions for a program. In this case it is really necessary that the program be entirely self-supporting. In the case of the game designed for the home computer, the completely self-supporting program will require as much as twice the program storage capability. This means a larger investment in memory and longer loading times with slow mass-storage devices. All in all, I think that it is much simpler to keep this issue of *Kilobaud* handy and refer to it whenever you need more information about the game. If you keep a separate notebook for your game programs, a trip to the nearest photocopier will preserve your magazine intact while excerpting the necessary information for the notebook.

You have already been introduced to a second feature of this program in the first part of the article. That feature is the use of metric units in the program. I happen to use metric units in my work every day. If the metric system is a mystery to you, all I can say is that it's about time you started learning about meters, kilometers and kilograms! The United States is not exactly rushing towards metrification, but the metric system is showing up in more and more applications around the country. It

```
0001 REM LUNAR LANDER GAME WITH ANALOG CONTROL OF ENGINE.
0002 REM MARK BORGERSON, JANUARY, 1977.
0003 REM WRITTEN FOR SWTPC 8-K BASIC MACHINE WITH MINIMUM
0004 REM OF 9K OF MEMORY AVAILABLE.
0005 RESTORE
0008 REM DATA FOR A-D CONVERSION. WILL LOCATE A-D SOFTWARE
0009 REM AT ADDRESS A015(HEX).
0010 DATA 40980,95,134,52,183,128,23,182,128,22,92,133,1
0015 DATA 39,248,247,160,20,134,60,183,128,23,57
0020 REM START A-D SETUP BY READING DECIMAL ADDRESS.
0025 READ A1
0030 REM DATA STORAGE LOOP
0035 FOR I=1 TO 23
0040 READ D1
0045 POKE( A1+I,D1)
0050 NEXT I
0051 REM NOW POKE ADDRESS OF A-D ROUTINE SO "USER" WILL KNOW
0052 REM WHERE THE ROUTINE IS LOCATED.
0055 POKE( 103,160)
0060 POKE( 104,21)
0061 REM SETUP OF A-D ROUTINE IS FINISHED.
0064 REM HERE IS INITIAL DATA FOR LUNAR LANDER.
0065 DATA 5000,100,3000,13000,1.65,0,0
0070 READ H,V,F,W,G,T,B
0074 REM NOW SET INTERVAL BETWEEN PRINT-OUTS IN SECONDS.
0075  I=2
0079 REM PRINT A "HOME UP" AND "ERASE SCREEN" FOR TVT-S.
0080 PRINT CHR$(16);CHR$(22);
0085 PRINT "***LUNAR LANDING SIMULATOR***"
0090 PRINT "DESCENT ENGINE TO MANUAL CONTROL"
0095 PRINT  "SEC  ALT  SPEED  FUEL  BURN  RATE"
0100 PRINT
0105 PRINT T; TAB(6);H;TAB(12);V;TAB(18);F;TAB(26);B
0108 REM DETERMINE AMOUNT OF FUEL TO BURN PER SECOND BY
0109 REM CALLING A-D ROUTINE AND SCALING RESULT.
0110  B=USER(0)+INT((PEEK(40980)-1)/2.4)
0115 IF F<=0 THEN B=0
0119 REM TOTAL ACCELERATION IS BALANCE BETWEEN G AND THRUST.
0120  A=G-1200*B/W
0124 REM COMPUTE NEW AMOUNTS OF FUEL AND TOTAL WEIGHT.
0125  F=F-B*I
0130  W=W-B*I
0134 REM COMPUTE NEW ALTITUDE.
0135  H=H-V*I-.5*A*I*I
0139 REM ROUND OFF HEIGHT TO A REASONABLE NUMBER OF DIGITS.
0145  H=INT(H*10+.5)/10
0150 IF H >10 H=INT(H+.5)
0154 REM COMPUTE NEW VELOCITY.
0155  V=V+A*I
0160  V=INT(V*10+.5)/10
0164 REM AUTOMATIC TOUCHDOWN WHEN HEIGHT IS LESS THAN 1 M.
0165 IF H <1 GOTO 185
0170 IF F <0 PRINT"FUEL EXHAUSTED"
0171 IF F <0 F=0
0175  T=T+I
0180 GOTO 105
0185 PRINT "***CONTACT***"
0189 REM COMPUTE TIME OF LANDING.
0190  D=I-(V+SQR(V*V+H*A*2))/A
0194 REM PRINT CLOSING MESSAGES AND EVALUATE PERFORMANCE.
0195 PRINT "TOUCHDOWN AT ";T+D;" SECONDS."
0200 PRINT "LANDING VELOCITY = "; V*3.6;" KM/HOUR."
0205 PRINT F;" KILOGRAMS OF FUEL LEFT."
0210 IF V >.5 GOTO 225
0215 PRINT "CONGRATULATIONS! AN EXCELLENT LANDING."
0220 GOTO 250
0225 IF V >5 GOTO 240
0230 PRINT "A LITTLE ROUGH, BUT YOU MADE IT."
0235 GOTO 250
0240 PRINT "YOU BLEW IT!"
0245 PRINT "APPROPRIATE CONDOLENCES WILL BE SENT TO YOUR FAMILY."
0250 INPUT "WANT TO TRY AGAIN",A$
0255 IF A$="YES" GOTO 5
0260 END
```

Program 1. Lunar Lander Game in SWTPC 8K BASIC.

```
***LUNAR LANDING SIMULATOR***

DESCENT ENGINE TO MANUAL CONTROL
SEC     ALT     SPEED   FUEL    BURN RATE

0       5000    100     3000    0
2       4798    102     2986    7
4       4592    104     2972    7
6       4383    105.3   2950    11
8       4171    106.6   2928    11
10      3957    107.5   2902    13
12      3741    108.4   2876    13
14      3524    109.1   2848    14
16      3305    109.6   2818    15
18      3085    110.1   2788    15
20      2864    110.6   2758    15
22      2642    111.1   2728    15
24      2419    111.6   2698    15
26      2195    112.1   2668    15
28      1970    112.6   2638    15
30      1747    110.8   2584    27
32      1529    106.9   2508    38
34      1321    101.2   2414    47
36      1128    92.3    2288    63
38      953     82.9    2158    65
40      797     73.2    2026    66
42      661     62 .9   1890    68
44      547     50.7    1736    77
46      458     38.3    1582    77
48      393     26.9    1440    71
50      349     17.6    1320    60
52      323     8.2     1200    60
54      315     -0.5    1088    56
56      315     0.4     1066    11
58      313     1.3     1044    11
60      310     2       1020    12
62      308     -0.1    970     25
64      308     -0.3    938     16
66      308     -0.1    910     14
68      308     0.6     886     12
70      306     1.9     868     9
72      301     3.2     850     9
74      293     4.5     832     9
76      283     5.8     814     9
78      270     7.3     798     8
80      254     8.6     780     9
82      236     9.2     756     12
84      217     9.8     732     12
86      197     10.6    710     11
88      175     11.7    690     10
90      151     12.8    670     10
92      127     11.6    630     20
94      110     5.9     550     40
96      100     3.7     502     24
98      93      3.6     472     15
100     86      3.2     440     16
102     79      3.5     414     13
104     71      4.3     392     11
106     61      5.5     374     9
108     49      6.7     356     9
110     34      8.4     342     7
112     16      9.8     326     8
***CONTACT***
TOUCHDOWN AT 114.301117 SECONDS.
LANDING VELOCITY = 32.04 KM/HOUR.
290 KILOGRAMS OF FUEL LEFT.
YOU BLEW IT!
APPROPRIATE CONDOLENCES WILL BE SENT TO
YOUR FAMILY.
WANT TO TRY AGAIN?
```

Fig. 1. Sample run of game.

is definitely time that it started to appear in the home computer environment. As a matter of fact, a good programmed-learning type computer game which teaches the metric system might earn you some very handy American dollars when you send it in to *Kilobaud.*

The lunar lander game itself is not too complicated once you get into the part of the program which simply plays the game for you (lines 65-255). That part of the program is based on some elementary laws of motion which you can verify in any book on basic physics. The calculations of the new velocity, altitude and fuel reserves are carried out in a loop which continues until the altitude is less than one meter. At this point you can imagine that the engines are automatically shut off for you.

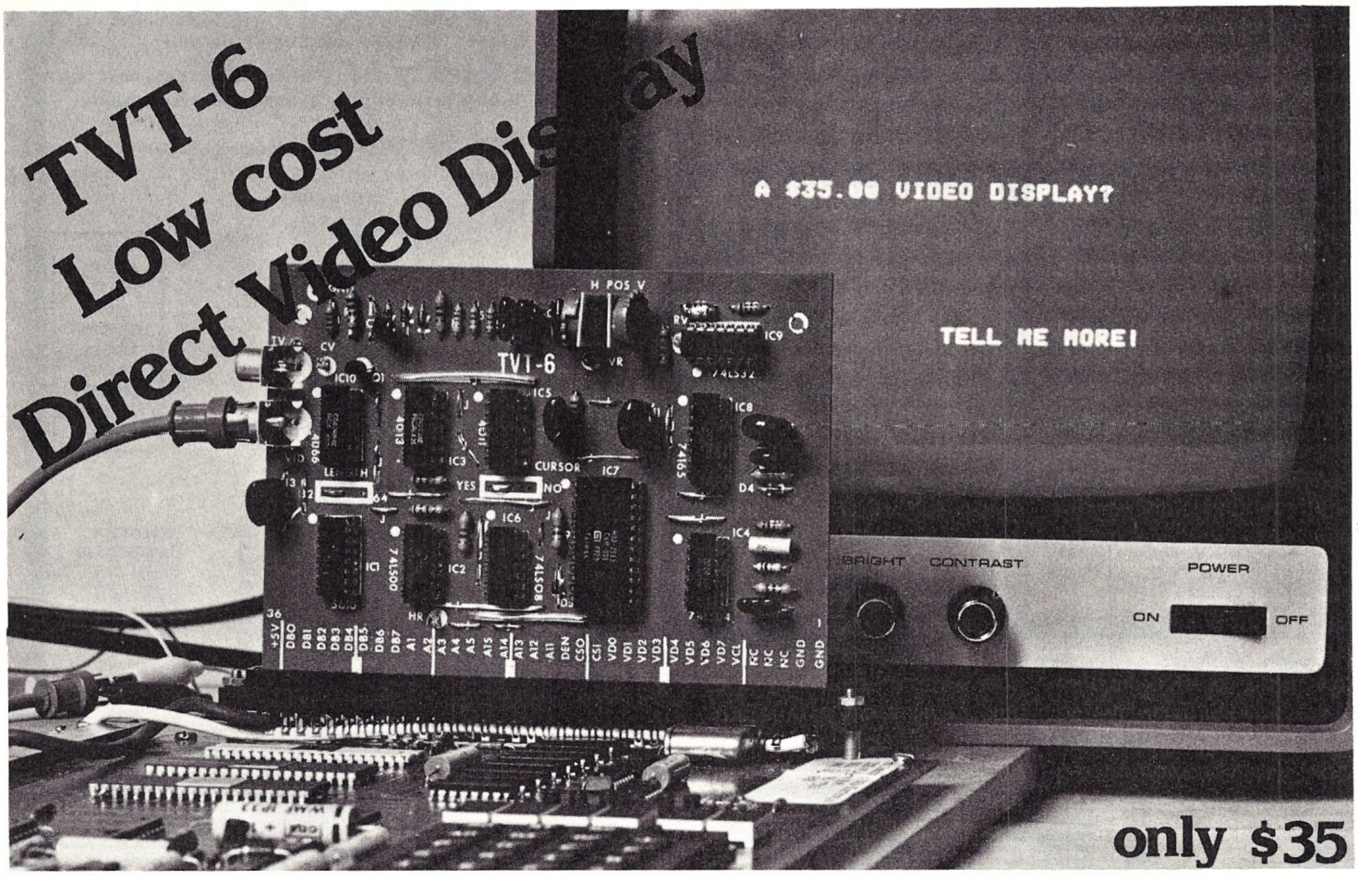
Lines 5 to 65 in the program contain the implementation of the analog-to-digital conversion routine. The operation of the analog-to-digital convertor was covered in an earlier article in this magazine. For this program the machine-language routine is loaded at address $A\emptyset 15_{16}$. This places the routine in the memory associated with the MIKBUG® operating system and leaves the rest of your RAM memory available for BASIC and the program. The machine-language routine is loaded into memory with the FOR-NEXT loop in lines 35-50. The hexadecimal code which will appear in memory is shown in Program 2. This routine assumes that your A-D input will be on channel one and that the A-D convertor uses a parallel input port at address 8018. If your A-D input is at another address, you will have to change the data statements so that the appropriate machine-language routine is loaded. If this seems to be too much trouble, you can simply eliminate program lines 10 to 60, use the PATCH command and load the hexadecimal code with MIKBUG.

As it appears here, the BASIC program requires about 9K of memory. If you want to try to squeeze it into an 8K machine, you can try eliminating lines 10-60, 85 and 90. Then try shortening all the text output in the PRINT statements. You should also note that the 9K estimate does not include any of the REM lines. As you can probably guess from the line numbers, I add these comments when the program is debugged and running. When I enter a program from a magazine into my computer, I usually don't type in the REM statements. This all goes back to my philosophy of keeping the documentation in the notebook, not in the computer memory.

Now for a few final notes before your first try at the Lunar Lander game. The input to the A-D convertor should be taken from a potentiometer connected across a 5 V supply. You can use almost any potentiometer with a total resistance of more than one thousand Ohms. Simply connect one end to the 5 V supply, the other end to ground and the wiper to the A-D input. If you have some problems with the touchiness of the control when your velocity is low and you only need a little thrust, try using a logarithmic taper potentiometer (sometimes called an *audio taper*) at the input. If you connect the pot properly, it will *spread out* the response in the low thrust region and *compress* it in the high thrust region.

The first thing you will notice about this game is that it illustrates very well why it takes several years to properly train an astronaut. This game is not trivial! It may take you quite a while to achieve your first successful landing. The sample game I have shown (in Fig. 1) is the result of my fifth game today. As you can see I managed to crash at about 32 km/hour. If you want to imagine that your capsule can take that type of shock, you can change the limits in the program to allow higher landing velocities.

If your terminal is a Teletype running at 10 characters per second, changing the value of I in line 71 to 5 will put the game back into a *real time* mode. It will also cut down the amount of paper used in a game. I guess that's enough training for now. It's now time to learn by doing! And remember, as the Ancient Aviator would say, "Any landing you can walk away from is a good one!" ■



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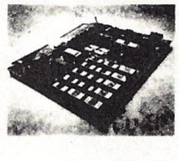

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A39

File Structures Simplified

... design your own operating system

David Yulke
121 Liberty Ave.
Selden NY 11784

For those of you sitting around contemplating the writing of your own disk operating system let me suggest Dave's article as an easy-going introduction to the file management end of the project. Dave is a Software Engineer for Applied Digital Data Systems. – John.

File structures, like so many areas of computers, can be a black art, the design being left to high-level software people. The purpose of this article is to make this subject as understandable as possible. This will be done while attempting to keep the buzzwords to a minimum.

In the world of software, I have found, by much painful experience, that before you can flowchart your program a specification must be acquired. This specification would describe what the end result of your programming efforts should be capable of doing. It could be entirely your own requirements or, more likely, a mixture of what others have and what you want. Deciding on a file structure is no exception.

The File Structure – What is it?

The standard floppy disk sold today is capable of storing 256,256 bytes of program or data using the standard IBM format. This storage space is physically organized as 77 tracks, each having 26 sectors. A sector is 128 bytes long. If you want to store more than one program on a diskette, you will be confronted with two problems. First, you will need a means of locating them. Second, if these programs are to be longer than one sector, you will need a method of linking sectors together to form a continuous stream of storage. A file structure is, therefore, a description of how programs are stored on a mass storage device such as a floppy disk.

The file structure, regardless of how simple or complex it may be, should solve both these problems for you. As a minimum, it should have an index area to store program or file names and their locations on the disk. If contiguous storage is acceptable, you could eliminate the need to link the sectors individually to a file. You would only have to know the start track and sector and the end track and sector. This is efficient only if the data will never be added to or deleted. For example, using this method: If you had four files on a disk and deleted the second file, you could only use the storage space freed

for a new file that was smaller or the same size as the deleted file.

A better file structure would partition the disk into logical blocks, or small segments of storage. These blocks would be allocated to a file as needed and freed up for a reallocation when a file is deleted. You would use a *bit map* of the diskette to show the current status of each block. A bit map would be a group of bytes organized so each bit represented the status of one block on the disk. If the block were active, or currently being used to store a portion of a file, the bit pertaining to that block would be a 1. If it were not in use, the bit would be a 0. However, you must pay for this convenience. First, the bit map will take up space on the disk. Second, you also must come up with a scheme to link the blocks that make up a file together so the file can be read as a contiguous block of storage. There are many methods of linking; a few will be discussed later.

The Specification — Putting Your Idea on Paper

One of the most important considerations here is the type of file required to do the job you have in mind. A simple file structure would allow only read sequential and write sequential access to files. This means you can open a file and write data to the end or read data from the beginning. You can append the file but not update it. To update a file using this method you would have to read the file, modify what you want, and write that into a new file. That sounds easy, but suppose you have a file 100,000 characters long and only want to make one change. You would have to spend an unreasonably long time reading and writing the entire file to make a simple change.

A more complicated file structure might easily support *random access* of files. Random access means what it says. If you divide a file into blocks on the disk why not be able to access any block separately and directly without reading all the blocks in the file? If your structure will support random access of the file, you can command your system to get the Nth block and modify this block alone. A practical application of random access files might be a home accounting system. Suppose you have a file for each creditor (e.g., electric co., phone co., mortgage, etc.). If you wanted a report on the bills for July last year, the system, without random access, would have to read each file from the beginning until it came across the month desired. With random access of these files, however, you could use a block per month. Then you would just calculate the block number for July and command the system to seek that block.

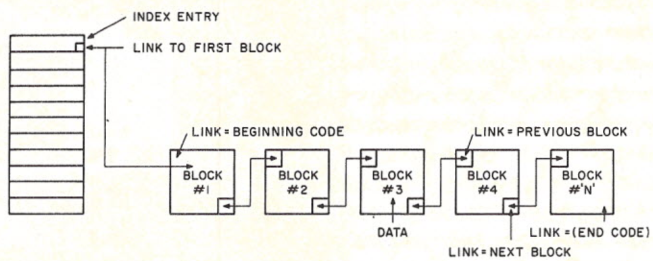

Fig. 2. Logical view of linked block structure. The beginning and end of the file are indicated by special codes instead of the next block address.

A. Scope or purpose of system
   1. Assembly language and BASIC operating system
   2. Data files requiring random access
B. File requirements
   1. Maximum file size: 200,000 characters (about 200 pages of assembly language source code)
   2. Minimum file size: 100 characters (a small BASIC program)
   3. Number of files per diskette: 200 (would allow multiple file basic accounting system)
C. Information needed for index display or file maintenance
   1. Name (up to nine characters)
   2. File attribute flags
      a. write protect
      b. system file
      c. executable binary file
      d. executable BASIC file
      e. assembly source file
   3. File size (in blocks)
   4. Pointer to last character of last block
   5. Pointers required to beginning of file

Fig. 1. File system specification.

The specification would also dictate the maximum and minimum file sizes expected. As you will see later, this will be helpful in determining the most efficient block size. If you intend to use floppy disks, a file would be limited to a quarter million characters, less the overhead required for your structure. The smallest file might be as small as one character. More realistically, it might be 100 characters or thereabouts.

You must have an idea how many files you will want to be able to keep on a single diskette. The more files desired, the larger the index area must be. The index area is where you would store, for quick access, certain information about each file. If you desire quick access to certain information about the file on a diskette, this should be listed in the specifications. The information might include file name (usually from six to ten characters), file type (if multiple types are supported such as ASCII, binary, BASIC, etc.), size of the file, date created and perhaps date last accessed. This will help determine what information each index entry will need.

Once you have the specifications written, let a fellow hobbyist or colleague read them and comment. There's nothing like another opinion to stimulate your own thinking. A typical specification might look like that of Fig. 1. Remember, the better organized your specification is, the easier your design will be to implement. Attempt to leave as few decisions open as you can.

Converting the Specification Into a Design

First you must see what

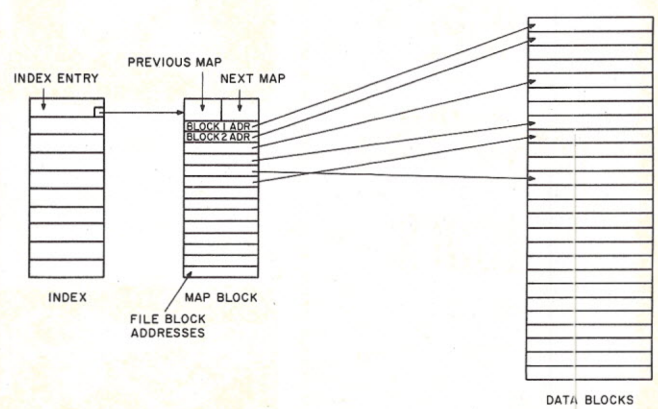

Fig. 3. Logical view of mapped block structure. Note that the maps are linked the way the blocks are linked in Fig. 1. The map is actually a block from the data block area of the disk.

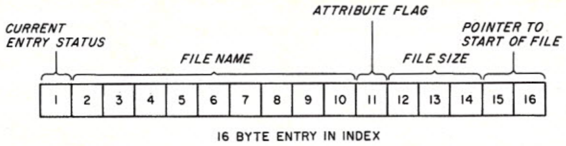

Fig. 4. A typical index entry. The most important information here is the file name and the pointer to the start of the file. The other information is for convenience.

structures are in use today and if one of them could meet the requirements of your specifications. This way you might be able to apply a proven design to your own application and not have to create a new design. The "not invented here" syndrome can only cost you needless time in the computer world. Certainly there are countless conventions for larger computer systems that are yet to be applied to micro systems. If you cannot find something that will closely satisfy your requirements, then you must design your own.

As mentioned, the file structure design will involve the following decisions: block size, index organization, linking methods and storage space management.

The block size should be as small as practical. In our specification we want a minimum file size of 100 bytes. Even the smallest of BASIC programs are greater than 100 bytes. It would seem logical to use 128-byte blocks in our example then, allowing one sector on the disk to be one block. The disadvantage of such a small block size is the overhead required to keep track of it all. First we need a bit map of all the blocks. If we have 128-byte blocks we would have 2002 blocks per disk (256,256/128 = 2002). This means we need 2002 bits in our map. This would require two blocks just for the bit map.

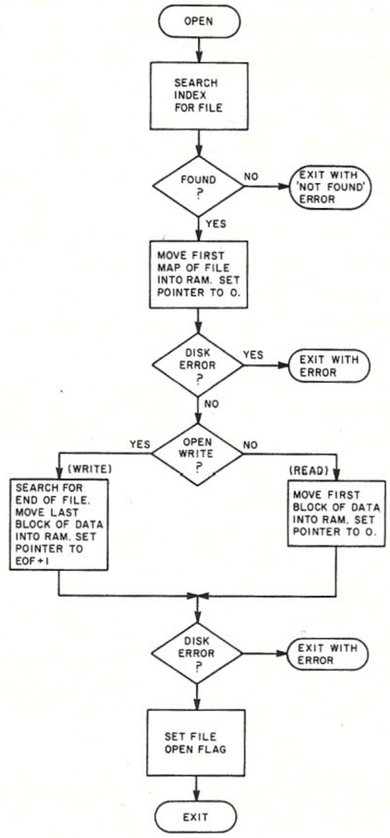

Fig. 5. Open file flowchart.

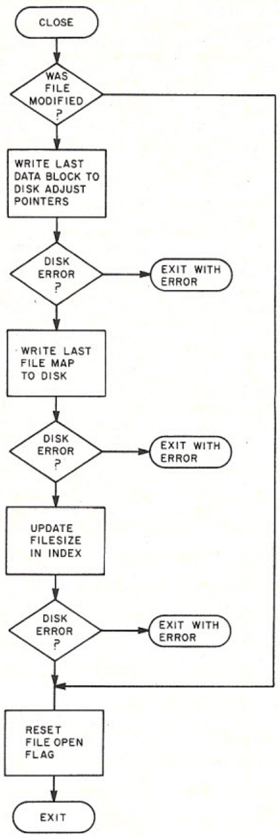

Fig. 6. Close file flowchart.

You also need a method to link these blocks to form a file. There are two common ways of doing this. One would be to have linking characters in each block as shown in Fig. 2. This would mean our usable block size would be 124 bytes (128 bytes less two bytes for the previous block address pointer and two bytes for the next block address pointer). With this scheme we could browse through a file with a minimum of disk head movement. This is an important consideration because head movement and load delays comprise a large percentage of disk access time.

Unfortunately this would mean you would have to read the file sequentially up to the block you wanted in a random access mode. As mentioned before, this could be time-consuming. Another approach would be to create a map of each file. You could store each block address in this map in the order they occur for that file (see Fig. 3). The maps could be linked the same way the data blocks were linked in the previous example. This way you could just read the maps and quickly find any block you desired in the file.

Again the trade-off is overhead. Using this last method, you would use, as overhead per file, a minimum of one block for the map plus the space for the index entry. A new map block must be allocated for every additional 62 blocks of data. Assuming the disk has only one file (minimum overhead) you would use about 32 blocks out of 2002 just for maps (2002/62 = 32.29). Actually this amounts to less than two percent of the usable disk area.

If you didn't plan on any small files, you could save some overhead by making the block size larger. For example, some available disk systems allocate disk space in 13-sector (½ track) blocks. These are linked via pointers in each block.

The index area of the disk is a very important consideration. Any information you wish to retrieve quickly about a file should be here. If you store too much information, you make a search for a file slow and use an unreasonable amount of space.

Besides storing the usual file names and pointers in the index area, you might want the size and certain attributes. Attributes are flags to show file status such as write protect, system file, etc.

The size would have to be modified every time the file was written to. This extra disk access might not be desired; therefore, the file size wouldn't be included in the index. Some file structures, such as IBM's 3740 (the original floppy disk file structure), store a minimum of information in the index. Others might use a *file header*, which is information stored at the beginning of a file, before the actual data. The software would know to

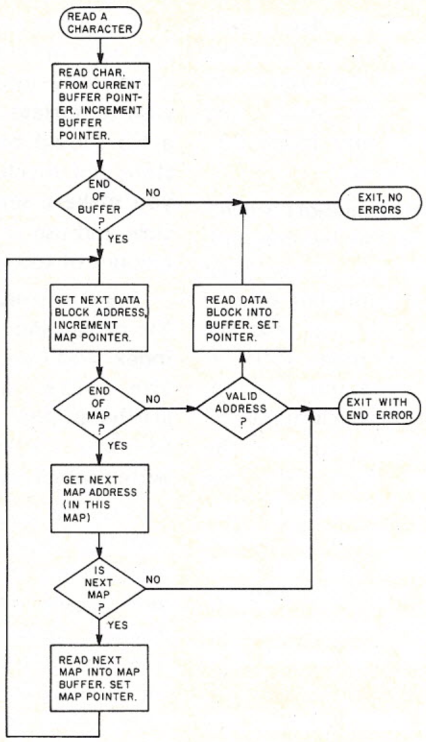

Fig. 7. Flowchart for reading a character from a disk file.

skip over this information when reading the data from the file. A block diagram of a typical index entry is shown in Fig. 4.

The status byte shows the current status of the entry position. Separate codes should be used for active, never used and deleted. The *deleted* entry would be used if you were to create a new file, but it would be ignored if searching for existing files in the index. When searching, the first *never used* entry position your software comes across would indicate the end of the active index area.

Once the basic design considerations are done and you are writing your own software, you should flowchart the routines required. These would include open, close, create a file, delete a file, read a character, write a character, seek and read a block, update current block, increment block address, decrement block address, etc. It is not the purpose of this article to flowchart all of these, but we will show an example of open, close, write a character, and read a character in Figs. 5 through 8. The flowcharts do not include any tests for areas such as trying to read a newly opened file with no data. The degree of such checking used would be up to the designer and his proposed application.

When you open a file, you would want to check first if the file exists. If it does, you create, in memory, a map of this file and set a flag showing that it is open. This map could consist merely of a pointer, or it could be a large map made of all the maps of the file.

Usually it is a compromise that keeps the current map in RAM. The more information you had available in fast RAM, the faster and more efficiently you could read a file. This might be important if you are planning on large files. Of course the more information you have in RAM, the more RAM you use (those nasty trade-offs again).

Reading a character from a file simply requires walking through the file one character at a time, calling in new maps when required. The end is known when the next block address is invalid. The actual end within the last block could be calculated from the size stored in the index.

When writing a character you might have to find a new block for data, if the current buffer becomes full, or even a new map block if the current map buffer becomes full. While attempting to allocate a data block or a map block, the disk could run out of room.

Because the map blocks are assigned as needed, they will appear buried in the file blocks of the disk, usually near the blocks they point to. This is good, as it means less disk head movement during a read operation.

Close resets pointers if the file wasn't written to but must save the final block and map if any additions were made to the file. Also it must update the size stored in the index.

The Real Live Example

Using the above process I have written software to support a file structure similar to that described here. It is intended for an operating system that will allow up to ten open files simultaneously and support multitasking. This means the system could assemble a source file and edit another at the same time. My system is a home brew 8080 computer with 36K of RAM, 10K of PROM, CRT display (24 lines x 80 characters), line printer, keyboard and dual floppy disks. Thus far it has done little else than educate me in this field, but that alone is well worth the money spent. I am about 40 percent finished with the coding/debugging effort of this operating system. The original planned completion date was June, but now it looks more like September. When and if that date occurs, I will consider another article, and possibly distribution of this software. If anyone else is interested or involved in such a project, I would like to hear from you. ■

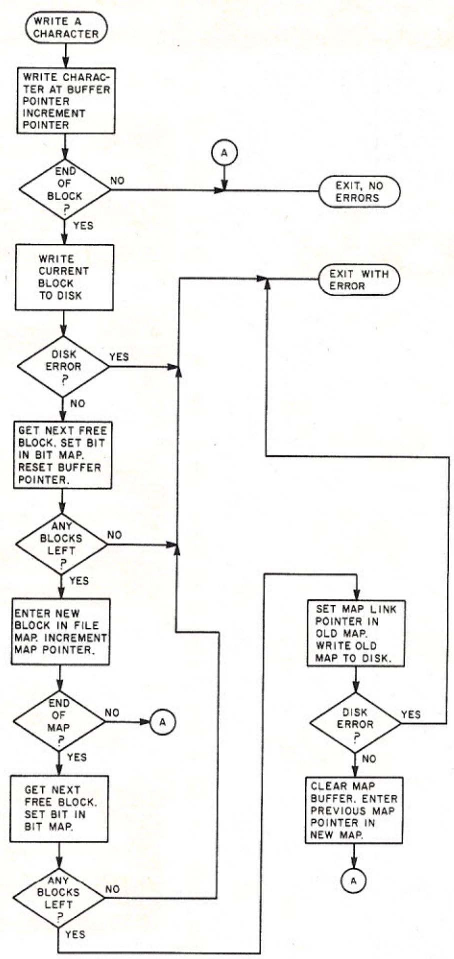

Fig. 8. Flowchart for writing a character to a disk file.

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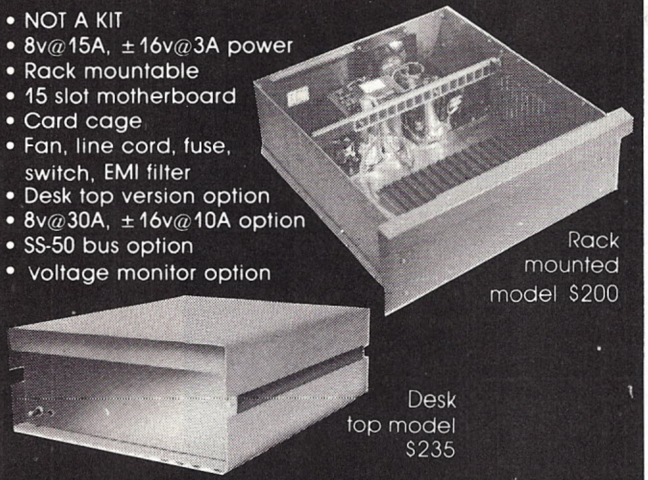

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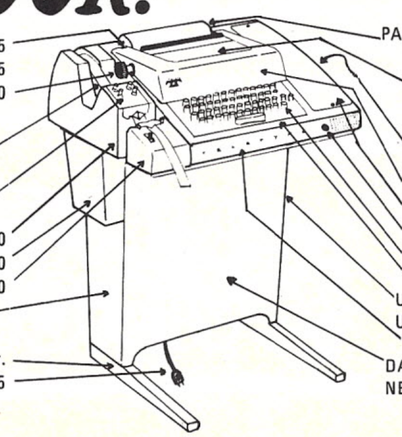

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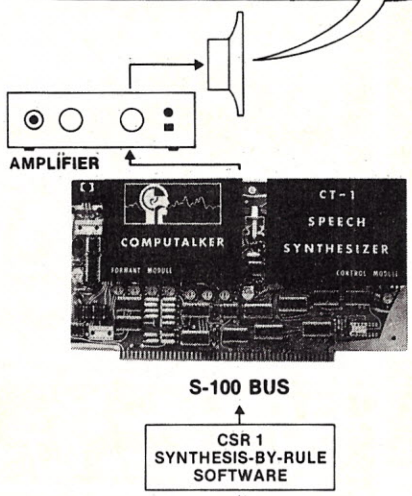

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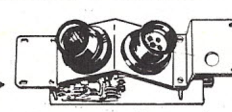

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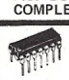

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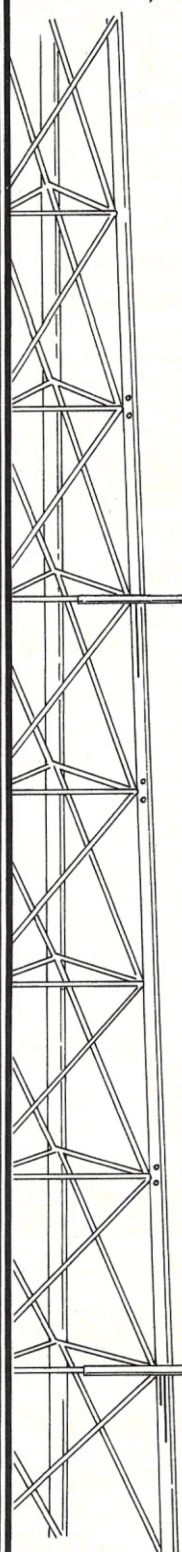

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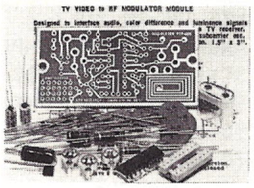

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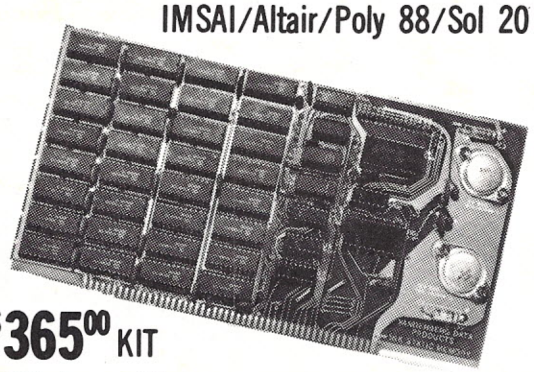

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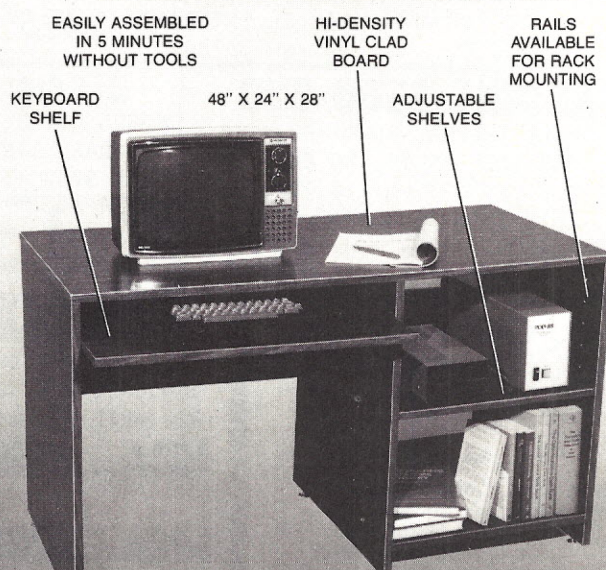

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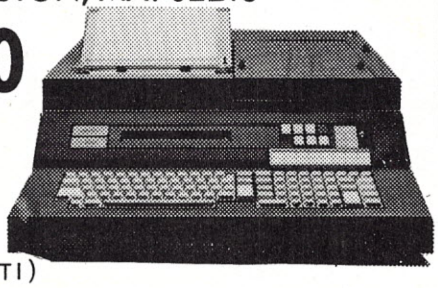

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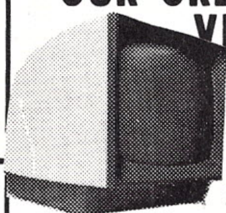

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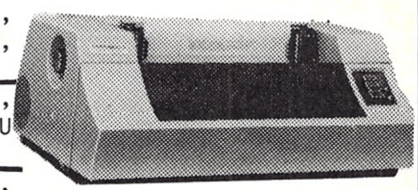

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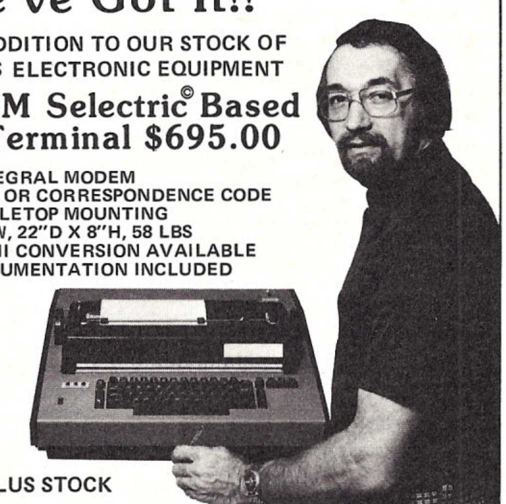

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1977 INDEX

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Votes are coming in regularly in our "Best Program of the Month" contest. (Kilobaud is offering a $100 prize to the author of the program voted best each month; monthly winners will compete for a $500 "Best Program of the Year" prize. Furthermore, there will be a drawing of all votes submitted. Winner gets his or her choice of any book we publish.)

We're now in the process of tallying votes for the best program in the October issue, which will be announced next month.

To vote, simply indicate your choice for the month on the Reader Service card in the back of that issue and send it our way.

CORRECTIONS

In "A TVT For Your KIM" by Don Lancaster (June, 1977), the PROMs IC2 and IC3 as listed as IM5600s in the parts list; they should be listed as IM5610s. In Fig. 8a, DECODE ENABLE pin 12, U9 should be pin 12, U4. In C Program for . . . Strolling Cursor, the branch instruction at address 011C should be 40, not 30. Our thanks to Jim Trageser of Kettering OH for bringing these corrections to our attention. We'll be hearing more from him in the future regarding the things he's doing with his TVT-6L.

In "Utilize ASCII Control Codes!" by Richard Wright (October, 1977), the unlabeled rectangular symbol on the left of Fig. 6(b) is a 555 timer. In Fig. 3 the pin numbers for outside world commands ACK and BEL are 7 and 9, respectively.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Required by 39 U.S.C. 3685). 1. Title of publication, Kilobaud. 2. Date of filing, 29 Sept. 1977. 3. Frequency of issue, Monthly. A. No. of issues published annually, 12. B. Annual subscription price, $15.00. 4. Location of known office of publication (Street, City, County, State and ZIP Code) (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 5. Location of the headquarters or general business offices of the publishers (Not printers), Pine Street, Peterborough, Hillsboro County, N.H. 03458. 6. Names and complete addresses of publisher, editor, and managing editor. Publisher (Name and Address) Wayne Green, Peterborough, N.H. 03458. Editor (Name and Address) John Craig, Peterborough, N.H. 03458. Managing Editor (Name and Address) John Barry, Peterborough, N.H. 03458. 7. Owner (If owned by a corporation its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) 1001001, Inc., Peterborough, N.H. 03458. W. Sanger Green, Route 3, Littleton, N.H. 03561. 8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (If there are none, so state) Name, none. 9. For completion by nonprofit organizations authorized to mail at special rates (Section 132.122, PSM) The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes (Check one) Not applicable. 10. Extent and nature of circulation. (X) Average No. copies each issue during preceding 12 months. (Y) Actual No. copies of single issue published nearest to filing date. A. Total No. copies printed (Net Press Run) (X) 48,880 (Y) 53,947. B. Paid circulation 1. Sales through dealers and carriers, street vendors and counter sales, none. 2. Mail subscriptions (X) 41,092 (Y) 46,653. C. Total paid circulation (Sum of 10B1 and 10B2) (X) 41,092 (Y) 45,653. D. Free distribution by mail, carrier or other means samples, complimentary, and other free copies (X) 118 (Y) 194. E. Total distribution (Sum of C and D) (X) 41,210 (Y) 45,847. F. Copies not distributed 1. Office use, left over, unaccounted, spoiled after printing (X) 7,097 (Y) 8,100. 2. Returns from news agents (X) 573 (Y) 0. G. Total (Sum of E, F1 and 2 — should equal net press run shown in A) (X) 48,880 (Y) 53,947. 11. I certify that the statements made by me above are correct and complete. Signature and title of editor, publisher, business manager, or owner. Sherry Smythe, Business Manager.

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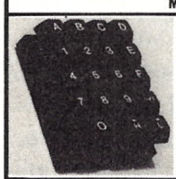

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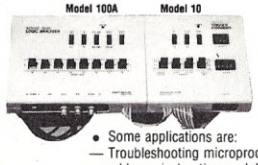

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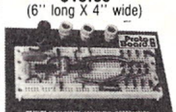

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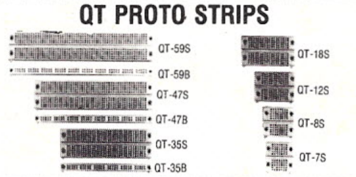

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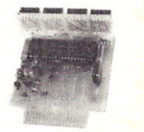

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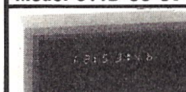

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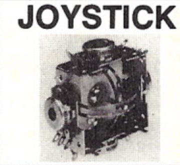
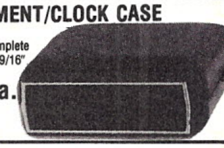


INSTRUMENT/CLOCK CASE

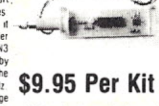
Injection molded unit. Complete with red bezal. 4½" x 4" x 1-9/16"

$3.95 ea.



JE803 PROBE

The Logic Probe is a unit which is for the most part, indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols: (H) - 1 (LOW) - o (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.



$9.95 Per Kit
printed circuit board

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only:

$9.95 Per Kit

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.10
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.25

Molex pins .01 To-3 Sockets .45

2 Amp Bridge 100-prv 1.20

25 Amp Bridge 200-prv 1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN	(Plastic .10)	.15
2N2907	PNP		.15
2N3906	PNP		.10
2N3054	NPN		.35
2N3055	NPN	15A 60v	.50
T1P125	PNP	Darlington	.35
LED Green, Red, Clear			.15
D.L.747	7 seg 5/8" high com-anode		1.95
XAN72	7 seg com-anode		1.50
FND 359	Red 7 seg com-cathode		1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	.95
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.60
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.70
4050	.50
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45

— T T L —

7400	.15	7473	.25	74176	1.25	74H72	.55	74S133	.45
7401	.15	7474	.35	74180	.85	74H101	.75	74S140	.75
7402	.20	7475	.35	74181	2.25	74H103	.75	74S151	.35
7403	.20	7476	.30	74182	.95	74H106	.95	74S153	.35
7404	.15	7480	.55	74190	1.75			74S157	.80
7405	.25	7481	.75	74191	1.35	74L00	.35	74S158	.35
7406	.35	7483	.95	74192	1.65	74L02	.35	74S194	1.05
7407	.55	7485	.95	74193	.85	74L03	.30	74S257 (8123)	.25
7408	.25	7486	.30	74194	1.25	74L04	.35		
7409	.15	7489	1.35	74195	.95	74L10	.35	74LS00	.35
7410	.10	7490	.55	74196	1.25	74L20	.35	74LS01	.35
7411	.25	7491	.95	74197	1.25	74L30	.45	74LS02	.35
7412	.30	7492	.95	74198	2.35	74L47	1.95	74LS04	.35
7413	.45	7493	.40	74221	1.00	74L51	.45	74LS05	.45
7414	1.10	7494	1.25	74367	.85	74L55	.65	74LS08	.35
7416	.25	7495	.60			74L72	.45	74LS09	.35
7417	.40	7496	.80	75108A	.35	74L73	.40	74LS10	.35
7420	.15	74100	1.85	75110	.35	74L74	.45	74LS11	.35
7426	.30	74107	.35	75491	.50	74L75	.55	74LS20	.35
7427	.45	74121	.35	75492	.50	74L93	.55	74LS21	.25
7430	.15	74122	.55			74L123	.55	74LS22	.25
7432	.30	74123	.55	74H00	.25			74LS32	.40
7437	.35	74125	.45	74H01	.25	74S00	.55	74LS37	.35
7438	.35	74126	.35	74H04	.25	74S02	.55	74LS40	.45
7440	.25	74132	1.35	74H05	.25	74S03	.30	74LS42	1.10
7441	1.15	74141	1.00	74H08	.35	74S04	.35	74LS51	.50
7442	.45	74150	.85	74H10	.35	74S05	.35	74LS74	.65
7443	.85	74151	.75	74H11	.25	74S08	.35	74LS86	.65
7444	.45	74153	.95	74H15	.30	74S10	.35	74LS90	.95
7445	.65	74154	1.05	74H20	.30	74S11	.35	74LS93	.95
7446	.95	74156	.95	74H21	.25	74S20	.35	74LS107	.85
7447	.95	74157	.65	74H22	.40	74S40	.25	74LS123	1.00
7448	.70	74161	.85	74H30	.25	74S50	.25	74LS151	.95
7450	.25	74163	.95	74H40	.25	74S51	.45	74LS153	1.20
7451	.25	74164	.60	74H50	.25	74S64	.25	74LS157	.85
7453	.20	74165	1.50	74H51	.25	74S74	.40	74LS164	1.90
7454	.25	74166	1.35	74H52	.15	74S112	.90	74LS367	.85
7460	.40	74175	.80	74H53J	.25	74S114	1.30	74LS368	.85
7470	.45			74H55	.25				
7472	.40								

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8266	.35	LM320K5 (7905)	1.65	LM340T24	.95	LM723	.50
MCT2	.95	LM320K12	1.65	LM340K12	2.15	LM725	1.75
8038	3.95	LM320T5	1.65	LM340K15	1.25	LM739	1.50
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LM301	.25	LM320T15	1.65	LM340K24	.95	LM747	1.10
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LM309H	.65	7805 (340T5)	.95	LM380	.95	LM1458	.95
LM309K (340K-5)	.85	LM340T12	1.00	LM709 (8,14 PIN)	.25	LM3900	.50
LM310	1.15	LM340T15	1.00	LM711	.45	LM75451	.65
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LM318 (Mini)	.65					NE556	.95
						NE565	.95
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MEMORY CLOCKS

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MM5314	3.00
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2102-1	1.75
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TR 1602B/ TMS 6011	6.95
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8T13	1.50
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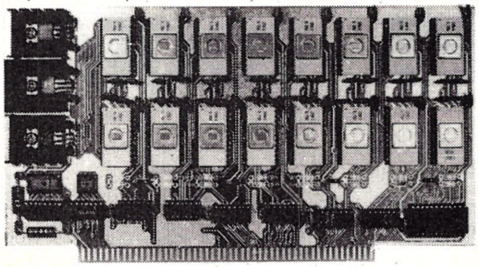
$69.95 (KIT)

S-100 (IMSAI/ALTAIR) BUSS COMPATIBLE



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KIT FEATURES:

1. Double sided PC Board with solder mask and silk screen and Gold plated contact fingers.
2. Selectable wait states.
3. **All** address lines and data lines buffered!
4. All sockets included.
5. On card regulators.

USES 2708's!

KIT INCLUDES ALL PARTS AND SOCKETS! (EXCEPT 2708's)

ADD $25 FOR ASSEMBLED AND TESTED

DEALER INQUIRES INVITED

SPECIAL OFFER: Our 2708's (650 NS) are **$12.95** when purchased with above kit.

FULLY STATIC! $149.00 KIT

8K LOW POWER RAM KIT!

KIT FEATURES:

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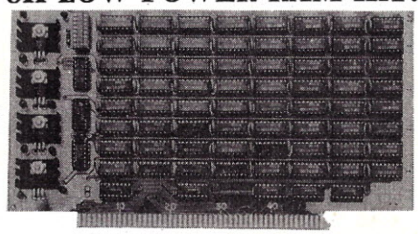

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TMS 4103 JC. 28 PIN CER DIP. Has seven bit COLUMN Output for use with Matrix hard copy devices. With specs.
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NEW! **4K STATIC RAM'S** **NEW!**
2114. The industry standard. 18 PIN DIP. Arranged as 1K X 4. Equivalent to FOUR 21LO2's in ONE package! TWO chips give 1K X 8, with data.
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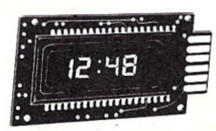
Not a kit. Complete tested module. Works on 12 VDC, has on board time base. Sold by others at $24.95. Big .30" Bright Green Digits. Same as used by Detroit in new cards.



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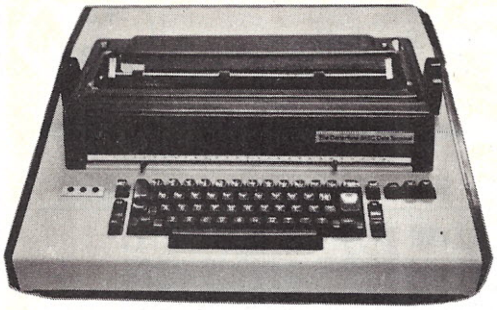

Specifications
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- Interface: RS232
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- Input/Output rates to 15 characters per second
- EBCD Code
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- Can be used off-line

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Working
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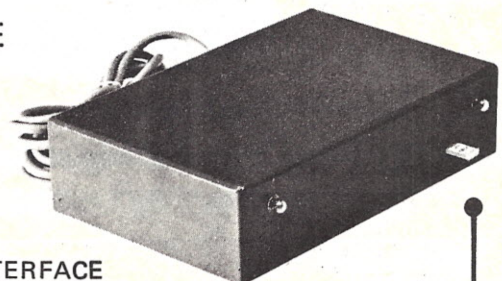
CARTERFONE MODEL 318 ASYNCH MODEM



- HARD WIRE
- TTY OR RS-232B INTERFACE
- ORIGINATE ONLY
- UP TO 300 BPS

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CF328 Acoustic version of same unit.

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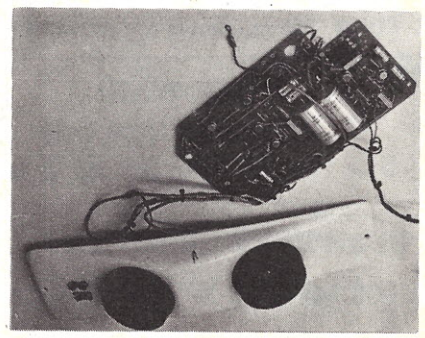

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Originate Only
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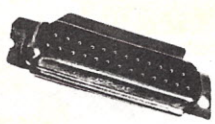
Physically fit into Model 33 Teletype.
Manufactured by Novation
$25 each

CANNON 25 PIN CONNECTOR



ITEM C-1
RS232
Male Connector NEW
$2.50 Each
Solder Type Cover **$1.00** Each

DEC LSI-11 COMPONENTS

All Items NEW

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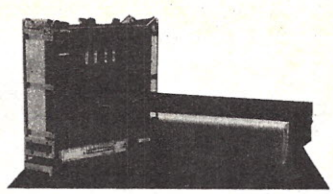

		List	Selling Price
CPU	(KDIIF)	$990	$795
SIO	(DLVII)	235	210
Card Cage	(H9270)	175	155
4K RAM	(MSVIIB)	625	550

Write for our CATALOG of many parts, terminals, printers, etc

SUGART MINI-FLOPPY DRIVE

NEW PRICE
$355.00 Each
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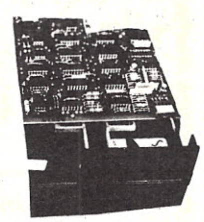
MODEL SA-400



SHIPPING INFORMATION:

Modems: $2.00 each; 2 for $4.00 UPS
Small Items & Parts: $2.00/order less than $20.00; $4.00/order $20.00 to $100.00; $6.00/order over $100.00
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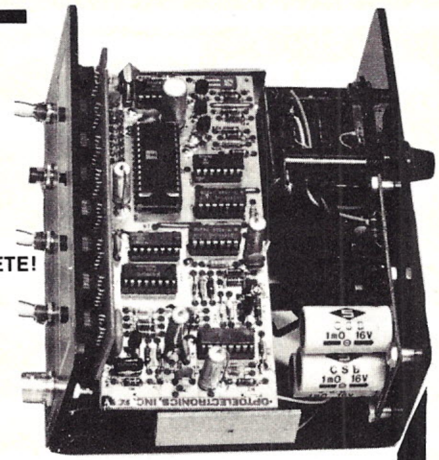

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SIZE:
3" High
6" Wide
5½" Deep

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5 V DC REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

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Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I
3"H,6¼"W,5½"D
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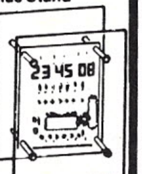
Black, White or Clear Cover
$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit
Clear Plexiglas Stand

- 6Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included



Plexiglas is Pre-cut & drilled

Kit #850-4 CP

Size: 6"H,4½"W,3"D

$23.50 ea. 2/$45. Assembled $29.95

60 HZ.
XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC.
1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit $4.95
Wir & Cal $9.95

SPECIAL PRICING!
PRIME - HIGH SPEED RAM
21L02-3 400 NS
LOW POWER - FACTORY FRESH

1-24	$1.75 ea.	100-199	$1.45 ea.
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1000 AND OVER $1.29 ea.

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DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

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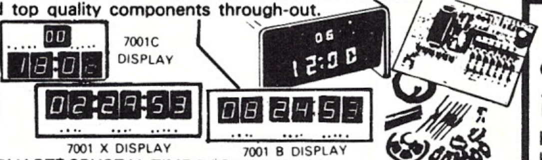
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95



KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

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A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

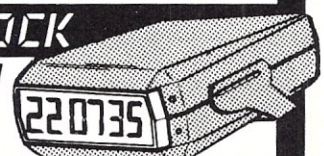
Kit #5314-5 $19.95 2/$38.

JUMBO DIGIT CONVERSTION KIT $9.95 ea.

Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.
Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.
Specify for 7001
B, C or X - $7.95

MOBILE LED CLOCK
12/24 HR .4" DIGITS!



MODEL #2001
12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT $27.95 EA. 3 OR MORE $25.95 ea. 115 VAC Power Pack #AC-1 $2.50 EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] $37.95 EA. 3 OR MORE $35.95 ea.
Wired for 12-Hr. Op. if not otherwise specified.

AUTO BURGLAR ALARM KIT

AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS. & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

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ORDERS TO USA & CANADA ADD 5% FOR SHIPPING, HANDLING & INSURANCE. ALL OTHERS ADD 10%. ADDITIONAL $1.00 CHARGE FOR ORDERS UNDER $15.00 - COD FEE $1.00. FLA. RES. ADD 4% STATE TAX.

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MICROCOMPUTER

MICROPROCESSOR's

F-8	19.95
Z-80	25.00
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CDP1802CD	24.95
AM2901	22.95
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8008-1	8.75
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6800 SUPPORT

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6828P	11.25
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3881	12.95
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3851	14.95
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1103	1.50
2104	4.50
2107A	3.75
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TMS4050	4.50
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MM5270	5.00
MM5280	6.00
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2513 UP	6.75
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2513 UP (5v)	9.95
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MCM6571	10.80
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1702A	5.00
2704	15.00
2708	20.00
2716	38.00
3601	4.50
5203AQ	4.00
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8212	3.95
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8224	4.95
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8251	12.00
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STATIC RAMS	1-24	25-99	100
21L02 (450)	1.50	1.40	1.25
21L02 (250)	1.95	1.80	1.50
21L11	4.25	4.10	3.95
1101A	1.49	1.29	1.10
2101-1	2.95	2.75	2.60
2102	1.25	1.15	1.00
2102-1	1.50	1.30	1.15
2111-1	4.00	3.50	3.25
2112-1	3.00	2.80	2.69
2114	17.95	16.95	16.50
31L01	2.50	2.35	2.00
3107	3.95	3.70	3.25
4200A	12.95	12.50	11.95
4804/2114	17.95	16.95	16.50
5101C-E	11.95	11.25	10.25
74C89	3.25	3.05	2.85
74S201	4.50	4.30	4.25
7489	2.25	2.10	1.90
8599	1.88	1.75	1.60
9102BPC	1.65	1.45	1.30

KEYBOARD CHIPS

AY5-2376	13.95
AY5-3600	13.95

UART'S

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AY5-1014A	8.95
TR-1602A	5.50
TMS-6011	6.95
IM-6402	10.80
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FLOPPY DISC CONTROLLER

1771B	55.95
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6530-004	15.95
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8038	4.00
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NH0025CN	1.70	P-3408A	5.00
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DM8098	.90	DM8131	2.75
1488	1.95	DM-8831	2.50
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D-3207A	2.00	DM-8835	2.50
C-3404	3.95	SN74LS367	.90
		SN74LS368	.90

TV Game Chip
TMS1955NL
Now Only $10.95

PerSci DISK AND CONTROLLER

Use the PerSci Disk and Controller now with the Info 2000 Adapter for the S-100 Bus.

INFO 2000 "SPECIAL" (includes Model 277 Dual Drive, Model 1070 Controller, Case with power supply and fan, and cable)	$2,150
Model 277 Dual Diskette Drive	$1,130
Model 1070 Controller	$740
Slimline case with power supply and fan	$280
Adapter for the S-100 Bus (Kit)	$120

JADE PARALLEL/SERIAL INTERFACE KIT
$124.95 KIT

JADE VIDEO INTERFACE KIT
$89.95 KIT

8K STATIC RAM BOARD

ASSEMBLED & TESTED

250ns.	$199.95
350ns.	$189.95
450ns.	$169.95

* WILL WORK WITH NO FRONT PANEL
* FULL DOCUMENTATION
* FULLY BUFFERED
* S100 DESIGN
* ADEQUATELY BYPASSED
* LOW POWER SCHOTTKY SUPPORT IC'S

KIT

250ns.	$169.95
350ns.	$139.95
450ns.	$129.95

IMSAI/ALTAIR **S-100** COMPATIBLE

JADE Z80 KIT

—with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

$135.00 EA. (2MHZ)

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BARE BOARD $35.00

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JADE 8080A KIT

— WITH EIGHT LEVEL VECTOR INTERRUPT

$110.00 KIT

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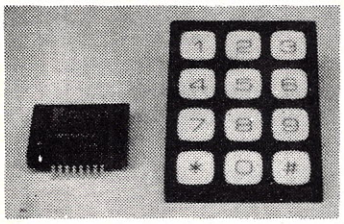
Discounts available at OEM quantities. Add $1.25 for shipping. California residents add 6% sales tax.

CATALOG FREE WITH $10.00 ORDER J6



TOUCH TONE ENCODER KIT

Simplicity itself to complete. No other parts required, no crystal required. The back of the touch pad has etched & drilled PC board and you solder the encoder chip to it. Add your own small speaker & 9 volt battery and you are done. A touch of the pad produces the proper tone signal from the speaker. We furnish schematic and instructions.

SP-149-B $12.95

WIRE WRAP WIRE

TEFZEL blue #30 Reg. price $13.28/100 ft. Our price 100 ft $2.00; 500 ft $7.50.

MULTI COLORED SPECTRA WIRE

Footage			10′	50′	100′
8	Cond.	#24	$2.50	9.00	15.00
12	″	22	3.00	11.00	18.00
14	″	22	3.50	13.00	21.00
24	″	24	5.00	20.00	30.00
29	″	22	7.50	28.00	45.00

Great savings as these are about 1/4 book prices. All fresh & new.

TOUCHTONE ENCODER CHIP

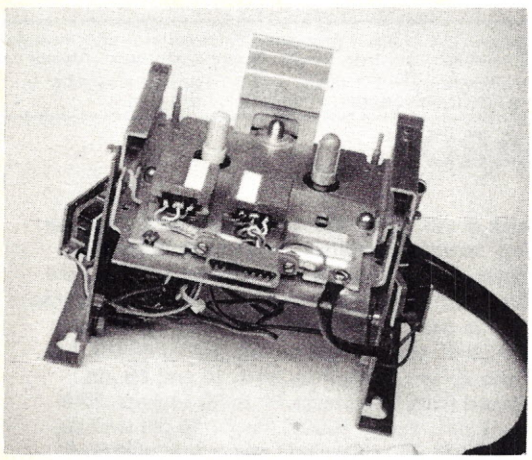
Compatible with Bell system, no crystal required. Ideal for repeaters & w/specs.
$6.00

CHARACTER GENERATOR CHIP

Memory is 512x5 produces 64 five by seven ASCII characters. New material w/data. $6.00

VIATRON CASSETTE DECKS

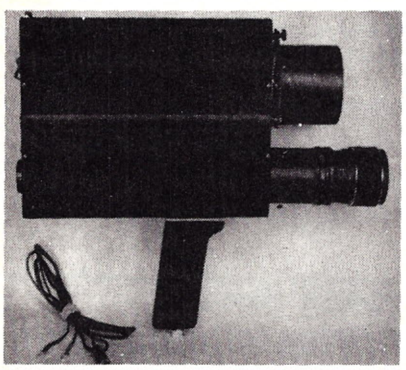
The computer cassette deck alone. $35



12″ GTE Monitor — used, checked out, good condition $60.00

Singer high speed Dot Matrix Printer

New in cartons, similar to Centronics, prints up to six (6) copies, 16″ width, 5 x 7 Dot matrix, 132 columns. No electronics or interface. Data supplied $300.00



IR NIGHT VIEWER $199.00

Custom made, complete with light source & viewer in one piece. Comes with carrying strap. Ready to operate with 6 volt lantern battery. Guaranteed by the manufacturer. See in total darkness. Great for scientists, viewing nocturnal animals & birds, criminal investigation . . . observe without being observed, and a ball for just plain snooping!!!! Sorry to say but no shipments to Calif. (lens may vary slightly from pic)
SPL-21 $199.00

Meshna

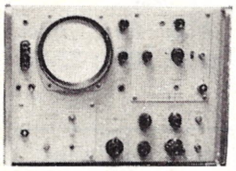
Please add shipping cost on above. Minimum order $10

FREE CATALOG NOW READY # SP-10

P.O. Box 62, E. Lynn, Massachusetts 01904

M2

HEWLETT PACKARD OSCILLOSCOPES MODEL 175A

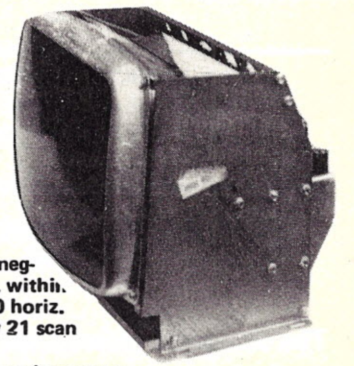


We have a limited supply of the famous HEWLETT PACKARD Model 175A Oscilloscopes. This scope has a 50 Mhz.bandwidth, and comes with 2 exotic plug ins, the dual channel Model 1750B, and the 1781 Delay Generator. Full specs on this scope and 2 plug ins would take this whole page, so we reccomend that you look in your HEWLETT PACKARD catalog. The prices as listed in the H–P catalog are as follows: Scope without plug ins, $1375.00. Model 1750B Dual trace plug in, $325.00. Model 1781B Delay Generator, $325.00, for a total of $2025. We are selling the scope and plug ins for $269.00, complete, guaranteed working, for less than the cost of a plug in. The 50 Mhz bandwidth is a must in todays high speed digital electronics. Shipping weight is about 85 lbs. Shipped by express only. You pay delivery charges on your end. We do not have the line cord or the manual at this time, but if they become available, they will be included. Manual is available from HEWLETT PACKARD.

A once in a lifetime chance to get a modern scope at surplus prices. Shipped from our Brockton, Mass. Warehouse

STOCK NO.0001. HEWLETT PACKARD 175A scope and plug ins $269.00

COMPUTER VIDEO MONITOR



A few months ago we advertised a limited quantity of 12" VIDEO MONITORS. We sold out in 2 days, as many of you know. We have now acquired another lot of 12" VIDEO MONITORS. These monitors are all in warranty returns to a large computer manufacturer. Rather than service these units, he replaced them with new units, and we acquired the lot. We have gone over them throughly, and guarantee them to be in working condition. We provide a 14 page service manual and wiring diagram. We also have a limited number of the metal cases and face masks that went with some of these units.

Some of the specifications are as follows: Signal input, Composite- video & sync, per RS 170, 1 to 2 volts p-p. sync polarity negative. Separate Vert. & Hor. Sync, 1 to 5 volts positive, can be changed to negative. Impedance, equivalent to 150K ohms, parallel with 15 pf. 75 ohm terminated. Video response, within 3 dB from 15 Hz to 15 Mhz. Resolution, center, 750, corner 650. Linearity, 1%. Picture Scan, 15,750 horiz. lines /sec. 47 to 63 Vert. pulses/sec. Horizontal retrace time 11 usec. max. Vertical retrace time, allow 21 scan lines per RS 170.

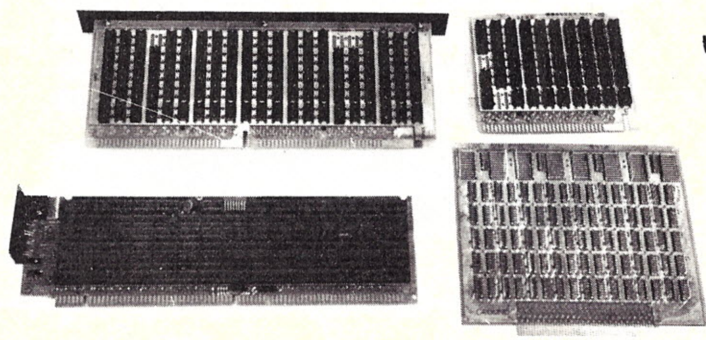
These monitors sold in excess of $250.00 each in quantities of 100. An opportunity to get a quality monitor at surplus prices.

STOCK NO.5525K VIDEO MONITOR, tested and working, with data Wt. 20 lbs. $89.50

VIDEOCUBE– TV COMPUTER INTERFACE KIT

VIDEOCUBE is a self contained RF oscillator and modulator which allows easy interface with any video outputdevice to a standard TV set. This device was descibed in August RADIO-ELECTRONICS. We provide a reprint of the article. Approved by FCC for radiation. Kit contains all parts as shown in the RADIO-ELECTRONICS article. STOCK NO.5500K $13.95 2/26.00

WIRE WRAP PROTOTYPE BOARDS



Wire wrap is the thing today, whether you are adding memory to your computer, building from scratch, Prototyping or designing new circuits etc. We have 4 boards. 2 out of equipment, and have wire on the pins that must be removed,(easy with an OK wire wrap tool, and 2 virgin boards. Board 6558K has from 75 to 100 sockets, both 14 and 16 pin. Board 6559K has from 40 to 50 sockets, 14 & 16 pin. Board 6592K has 40 16 pin sockets, & 4 LSI 24 pin sockets and is gold plated. all pins are brought up to top of board for ease in wiring. Board 5561K has 87½ sockets, 28 16 pin sockets and a 4 pin socket. These boards are all heavily by-passed between Vcc and ground planes. Some of the boards in this number contain 4 LEDs, 2 red, a yellow and a green. and a 4 position thumb wheel switch, with all leads brought out to wire wrap pins.

All boards advertised have Vcc and ground planes, and all have gold contacts for standard edge connectors.

STOCK NO.6558K 75 to 100 sockets , 5¾"x13¾",removed from equipment $18.75 ea. 2/35.00

STOCK NO.6559K, 40 to 50 sockets, 6"x6½", removed from equipment $11.75ea 2/22.00

STOCK NO.6592K 40 16 pin sockets , 4 LSI sockets, 6¾"x8¾" Gold Pl. New $24.50 2/45.00

STOCK NO.5561K 88½ sockets , 4½"x14½" New. $29.50 ea. 2/55.00

5 VOLT 8 AMP. ±12 VOLTS 2 AMP. HIGHLY REGULATED POWER SUPPLY

Beautifuly built supplies, removed from rental computer equipment.Mfgr. is upgrading system,making these original cost $300.00 supplies available. Also has ±6 volts @ 75 ma. 11"x5"x4½". 12 lbs. fused, 3 wire power cord. Tested and guaranteed.
STOCK NO.5554 $34.50 ea. 2/65.00

DELTA ELECTRONICS

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Amesbury, Mass. 01913
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your BANKAMERICARD welcome

master charge

Visit our retail outlets: DELTA ELECTRONICS HOBBIES, 5151 Buford Hwy. Doraville, (Atlanta) Ga. & DELTA ELECTRONICS WAREHOUSE OUTLET, 590 Commonwealth Ave. Boston, Mass. Oscilloscope & Video terminal sent express, shipping charges collect. All else, enclose sufficient postage. Excess will be refunded.

D13

S.D. SALES COMPANY

NOW-THE ULTIMATE RAM BOARD

MEMORY CAPACITY
MEMORY ADDRESSING
MEMORY WRITE PROTECTION

8K, 16K, 24K, 32K using Mostek MK4115 with 8K boundaries and protection. Utilizes DIP switches. PC board comes with sockets for 32K operation. Orders now being accepted allow 6 to 8 weeks for delivery.

Available the 1st quarter of 1978: 16K, 32K, 48K, 64K using Mostek 4116 with 16K boundaries and protection.

32K FOR $475.00

Buy an S100 compatible 8K Ram Board and upgrade the same board to a maximum of 3 2 K in steps of 8K at your option by merely purchasing more ram chips from S.D. Sales! At a guaranteed price — Look at the features we have built into the board.

PRICES START AT $151. FOR 8K RAM KIT
Add $108.00 for each additional 8K Ram

Board fully assembed and tested for $50. extra.

8K FOR $151.00

INTERFACE CAPABILITY
Control, data and address inputs utilizes low power Schottky devices.

POWER REQUIREMENTS
+8VDC 400MA DC
+18VDC 400MA DC
−18VDC 30MA DC
on board regulation is provided. On board (invisible)refresh is provided with no wait states or cycle stealing required.
MEMORY ACCESS TIME
IS 375ns.
Memory Cycle Time is 500ns.

8K LOW POWER RAM - $159.95

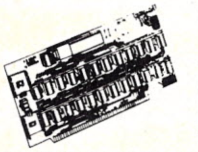
Fully assembled and tested. Not a kit.
Imsai —Altair — S-100 Buss compatible, uses low power static 21L02-500ns fully buffered on board regulated, quality plated through PC board, including solder mask. 8 pos. dip switches for address select.

4K LOW POWER RAM KIT

Fully Buffered — on board regulated — reduced power consumtpion utilizing low power 21L02 — 1 500ns RAMS — Sockets provided for all IC's. Quality plated through PC board. *Add $10. for 250ns RAM operation

The Whole Works-$79.95

Z-80 CPU BOARD KIT - Complete Kit $139.



CHECK THE ADVANCED FEATURES OF OUR Z—80 CPU BOARD:
Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply; always stops on an M1 state, true sync generated on card (a real plus feature!), dynamic refresh and NMI available, either 2MHZ or 4MHZ operation, quality double sided plated through PC board; parts plus sockets priced for all IC's. *Add $10. extra for Z—80A chip which allows 4MHZ operation. Z—80 chip with Manual — $39.95

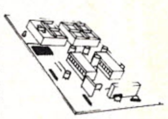
MUSICAL HORN

One tune supplied with each kit. Additional tunes — $6.95 each. Special tunes available. Standard tunes now available: —Dixie — Eyes of Texas — On Wisconsin — Yankee Doodle Dandy — Notre Dame — Pink Panther — Aggie War Song — Anchors Away — Never on Sunday — Yellow Rose of Texas — Deep in the Heart of Texas — Boomer Sooner — Bridge over River Kwai

Special Design Case $3.50

CAR & BOAT KIT	HOME KIT
$34.95	$26.90

DIGITAL LED READOUT THERMOMETER - $29.95



Features: Litronix dual 1/2" displays. Uses Silicoaix LD131 single chip CMOS A/D converter. Kit includes all necessary parts (except case); AC line cord and power supply included. O-149° F

6 DIGIT ALARM CLOCK KIT

Features: Litronix dual 1/2" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). Xfmr optional. Eliminate the hassle — avoid the 5314! Do not confuse the Non — Alarm kits sold by our competition!
AC XFMR — $1.50 Case $3.50 **$12.95/kit**

Jumbo LED Car Clock Kit

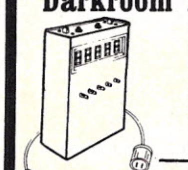
$16.95

FEATURES:
A. Bowmar Jumbo .5 inch LED array.
B. MOSTEK — 50250 — Super clock chip.
C. On board precision crystal time base.
D. 12 or 24 hour Real Time format.
E. Perfect for cars, boats, vans, etc.
F. PC board and all parts (less case) inc.
Alarm option — $1.50
AC XFMR — $1.50

Bowmar 4 Digit LED Readout Array

4 JUMBO .50" DIGITS ON ONE STICK!
WITH COLONS & AM/PM INDICATOR
$3.95

5 Digit Countdown Utility— Darkroom Timer Kit - $44.95



Features: Large LED ½" displays, crystal controlled Mostek 50397 counter display driver, set timer at 0.1 second precision from 0.1 second to 59 minute 59.9 second, 5A-115V relay included to control photographic enlarger, sun lamp, appliances, TV, or other equipment, operates on 115V AC, displays can be turned off for total darkness applications, simple push button operation, use in kitchen, school, office or laboratory. All necessary parts included. Special design case $3.75

6 Digit General Purpose or Computer Timer Kit - $29.95

Features: Large LED ½" displays, Mostek 50397 counter display/driver, counts up to 59 minutes, 59.99 seconds with crystal controlled 1/100 second accuracy, operates on 115V AC or 12V DC supply. Use it to time telephone calls, athletic events, practice time, school and laboratory demonstrations, experiements, chess games, etc. Time computer functions in real time such as run times on programs, sub routines and other computer controlled events. Requires two output channels for start/stop and clear controls. All necessary parts included. Special design case $3.75

Full ½" Litronix Jumbo Dual Digit LED Displays

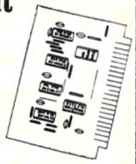
DL 722 - C.C.	DL 728 - C.C.
DL 721 - C.A.	DL 727 - C.A.
99c	$1.29

RAM'S•CPU'S•PROM'S

21L02 - 500NS	8/11.50
21L02 - 250NS	8/15.95
2114 — 4K	14.95
1101A — 256	8/$4.00
1103 — 1K	.99
MK 4115 - 8K	19.45
74S 200 - 256	3.95
Z—80 includes manual	29.95
Z—80A includes manual	34.95
8080A CPU 8 BIT	11.95
8008 CPU 8 BIT	6.95
1702A - 1K - 1.5us	3.95 or 10/35.
2708 - 8K Intel - 450ns	14.95
5204 - 4K	7.95
82S129 — 1K	2.50
2708S - 8K signetics 650ns	9.95

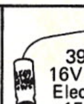
Low Cost Cassette Interface Kit

$14.95



Features: K.C. standrad 2400/1200 Hz, 300 Baud, TTL, I/O compatible, phase lock loop, 22 pin connector. Feeds serial data via microprocessors I/O ports and from cassette tape recorder. $14.95

DISC CAP ASSORTMENT *
PC leads. At least 10 different values. Includes .001., .01, .05 + other standard values 60/$1.00



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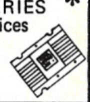

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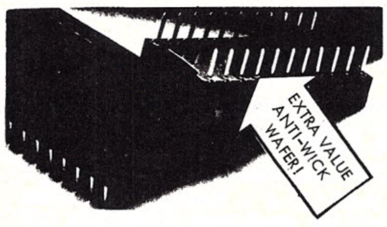

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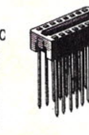
SKT-0802 8 pin	.15	.15	.14
1402 14pin	.18	.17	.16
1602 16pin	.20	.19	.18
1802 18pin	.27	.26	.25
2002 20pin	.29	.28	.27
2202 22pin	.35	.34	.33
2402 24pin	.36	.35	.34
2802 28pin	.42	.41	.40
4002 40pin	.60	.57	.53

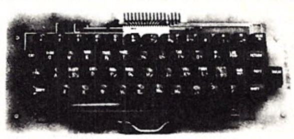
3 Level Wire Wrap Gold

	1-9	10-24	25-100
SKT-1400	.38	.37	.36
1600	.42	.41	.40
1800	.73	.65	.59
2400	1.00	.91	.83
4000	1.69	1.51	1.37



RIBBON CABLE IC INTERCONNECTS


No Of Pins	6"	12"	18"	24"	36"	48"
SINGLE END						
14P ······	1.51	1.62	1.72	1.83	2.05	2.26
16P ······	1.64	1.76	1.87	1.99	2.21	2.44
24P ······	2.49	2.69	2.88	3.08	3.48	3.87
DOUBLE END						
14P ······	2.76	2.87	2.97	3.08	3.30	3.51
16P ······	3.01	3.13	3.24	3.36	3.58	3.81
24P ······	4.55	4.75	4.94	5.14	5.54	5.93



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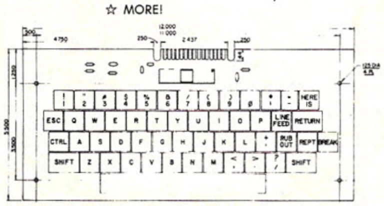

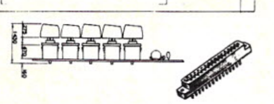

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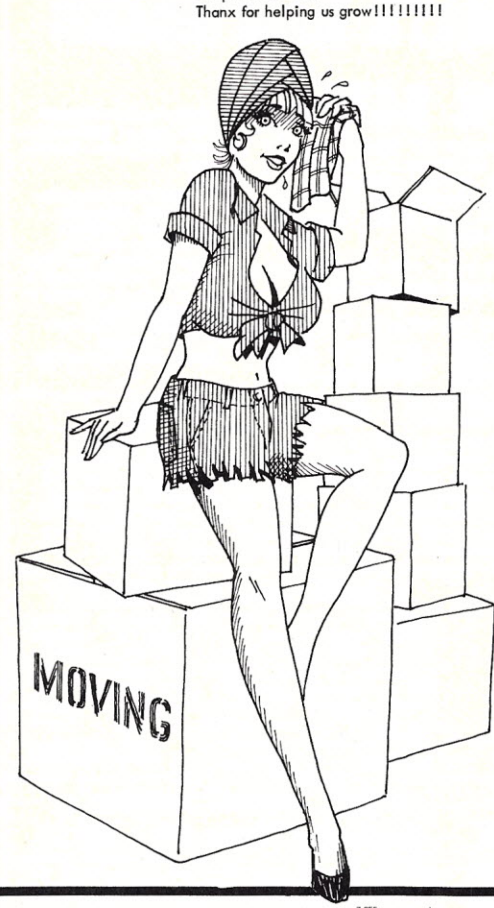

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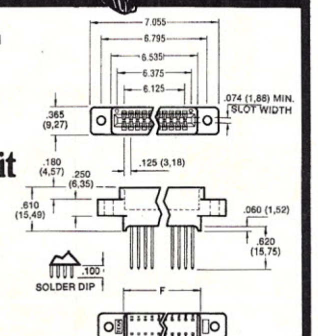

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Solder-tail length pins are of heavy square cross-section avoiding the fold-over problems associated with light guage-sheet metal pins. Available in gold or the new NASGLO® tin-nickel plate which has low current properties similar to gold.

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MM57109 MOS/LSI Number-Oriented Microprocessor

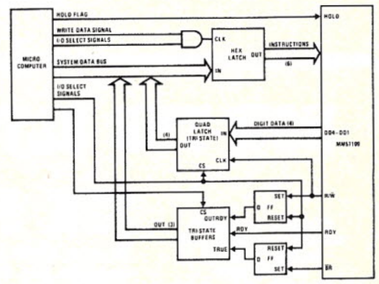


FIGURE 13(a). MM57109 as a Microprocessor/Microcomputer Peripheral

The MM57109 is an MOS/LSI number oriented microprocessor intended for use in number processing applications. Scientific calculator functions, test and branch capability, internal number storage, and input/output instructions have been combined in this signle chip device. Programming is done in calculator keyboard level language with software development simplified and generated code more reliable because algorithms are preprogrammed in an on-chip ROM. Data or instructions can be synchronous or asynchronous; I/O digit count, I/O notation mode, and error control are user programmable; a sense input and flag outputs are made available for single bit control.

MM57109 can be used as stand alone processor with external ROM/PROM and program counter. Alternatively it can be configured as a peripheral device on the bus of a micro processor or minicomputer.

FEATURES:
*Scientific calculator instructions (RPN)
- O Up to 8-digit mantissa, 2-digit exponent
- O Four-register stack, one mem register
- O Trig and Log functions, Y^X, e^X, pi, etc.
- O Error flag generation and recovery

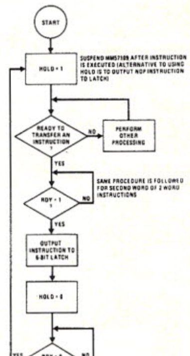
*Flexible I/O
- O Hold for single stepping and async operation
- O Asynchronous digit input with ready
- O Multidigit I/O with F.P. or scientific
- O Programmable mantissa digit count for I/O
- O Sense input and flag outputs

*Branch Control
- O Conditional and unconditional branching
- O Increment/decrement branch on non-zero for program loops

*Interface Simplicity
- O Single ø clock
- O Low power operation
- O Generation of I/O control signals
- O Separate digit input, output, and address bus

Save memory space, increase algorithm speed, add to your BASIC or FORTRAN capabilities with this super number cruncher. Put it on your S-100 bus system and be ready for the new soft-ware packages coming out in the near future.

MM57109N......with spec booklet.........$21.92
Specs only for MM57109....................$2.00



FUNCTION	MM57109
I/O	Multidigit asynchronous digit single bit
Data format	Floating point Scientific Notation
Data length	Variable (1 to 8 digit mantissa)
Program	External ROM/ PC, µP or FIFO
Speed (math or I/O operations)	0.5 400 ms
Minimum number of chips for CPU and RAM	1 (external PC and program source)

FIGURE 13(b). Microprocessor Software for MM57109 Peripheral Interface

tri-tek, inc.
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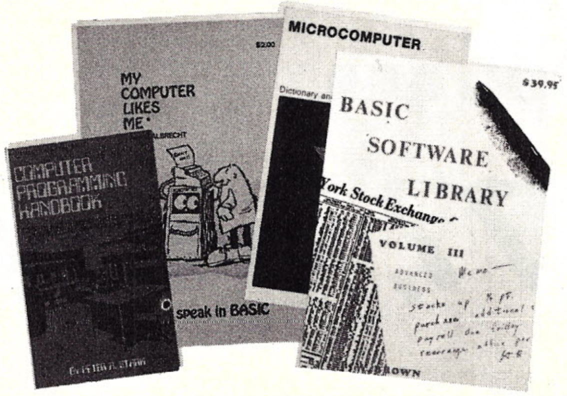

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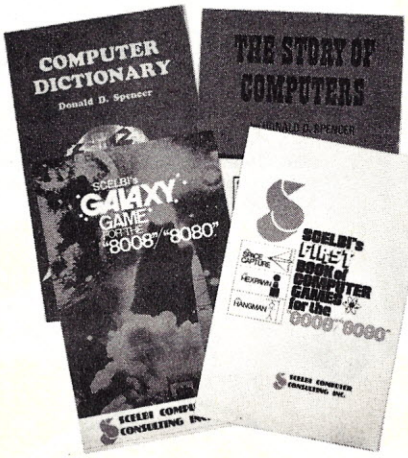

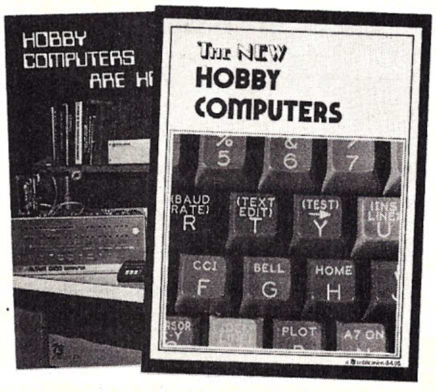

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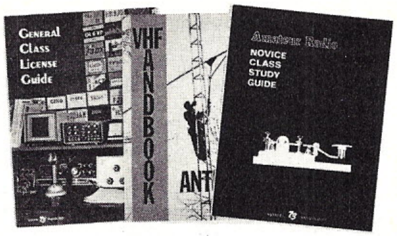

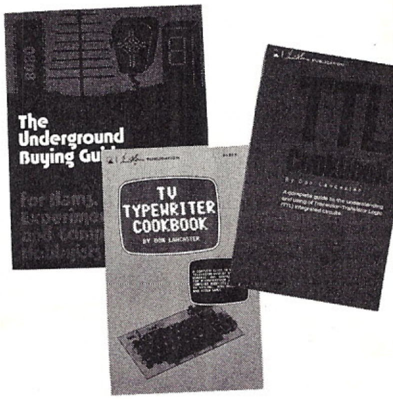

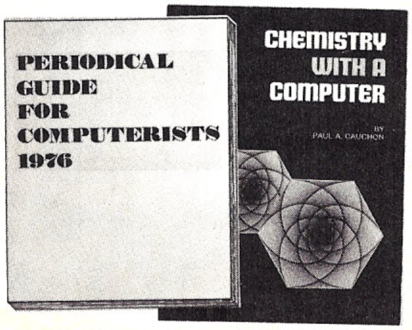

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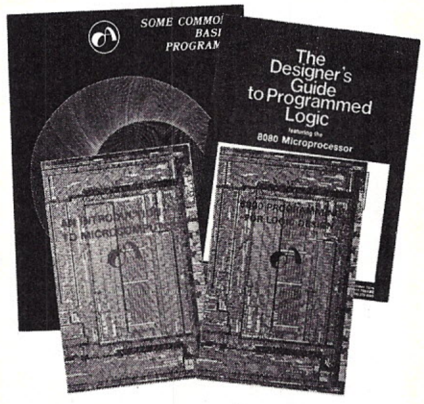

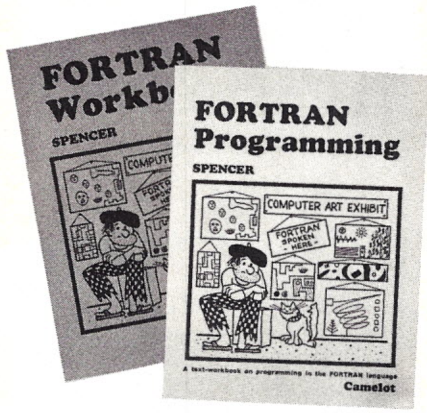

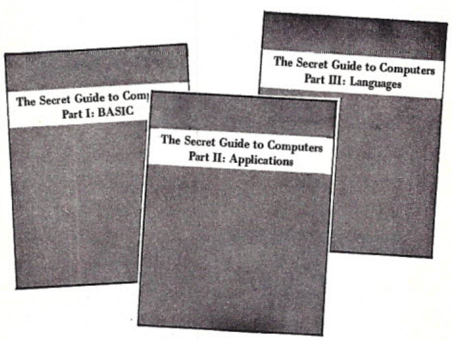

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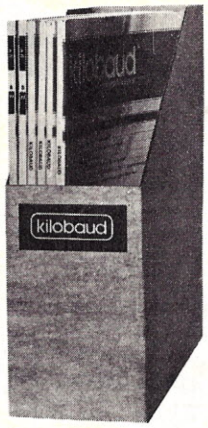

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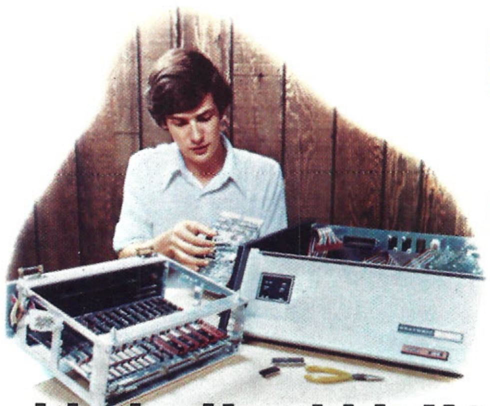

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